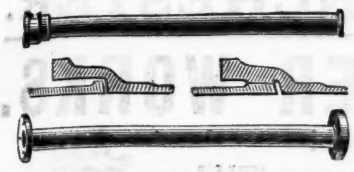
THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXV. No. 1670.] LONDON, MAY 14, 1895. [47TH YEAR. PRICE 6d.

GAS AND WATER PIPES

1¼ to 12 IN. BORE.



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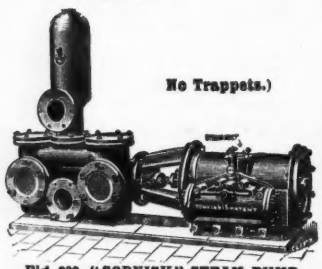

No Trappets.)

Fig. 600. "CORNISH" STEAM-PUMP FOR WATER.

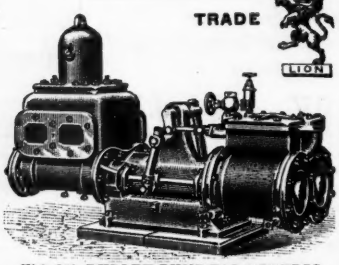

Fig. 670. DUPLEX PUMP FOR GENERAL PURPOSES.

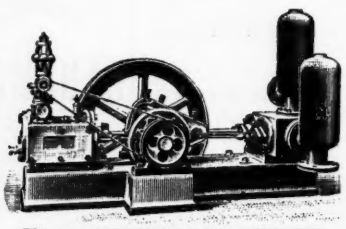

Fig. 683. "RELIABLE" PUMP FOR TAR AND THICK FLUIDS.

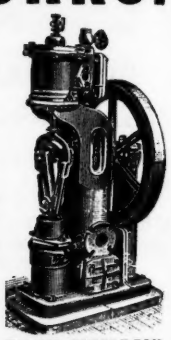

Fig. 705. SINGLE RAM PUMP FOR BOILER FEEDING, &c.

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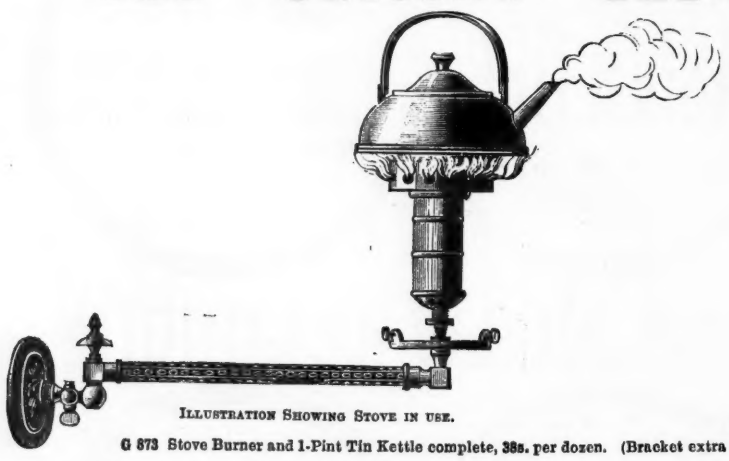
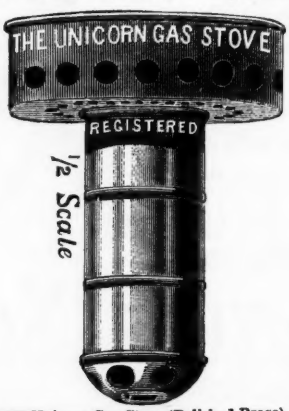


Illustration Showing Stove in use.

G 873 Stove Burner and 1-Pint Tin Kettle complete, 38s. per dozen. (Bracket extra



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G 870
Cast Unicorn Burner
5s. per dozen.

THIS STOVE is **invaluable** for **Bedrooms** and **Kitchens. No other Gas-Stove equals it for quickness.** It simply slips over the Burner which is supplied with the Stove, and which thereby is at once converted into an atmospheric burner. When the Burner is not needed for the Stove, it remains in the bracket, and acts as an ordinary Comet Burner. The Kettle has a sunk well, and rests securely on the Stove, **which must always be lighted from the top.**

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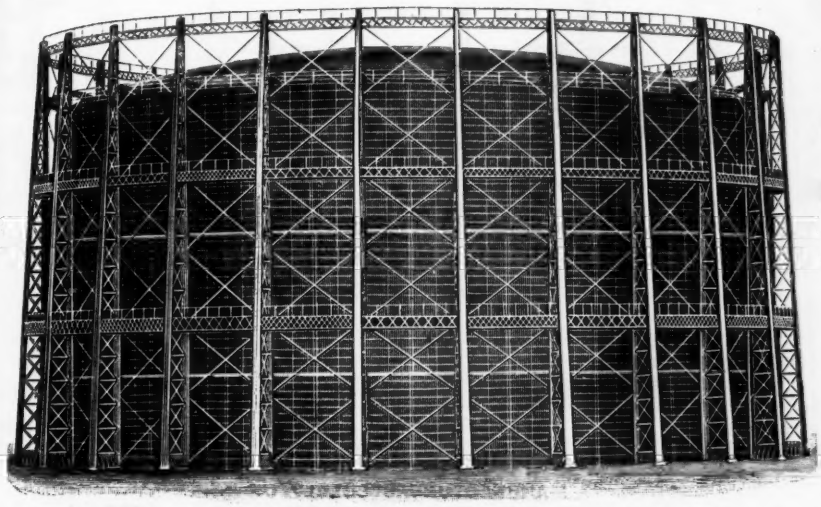

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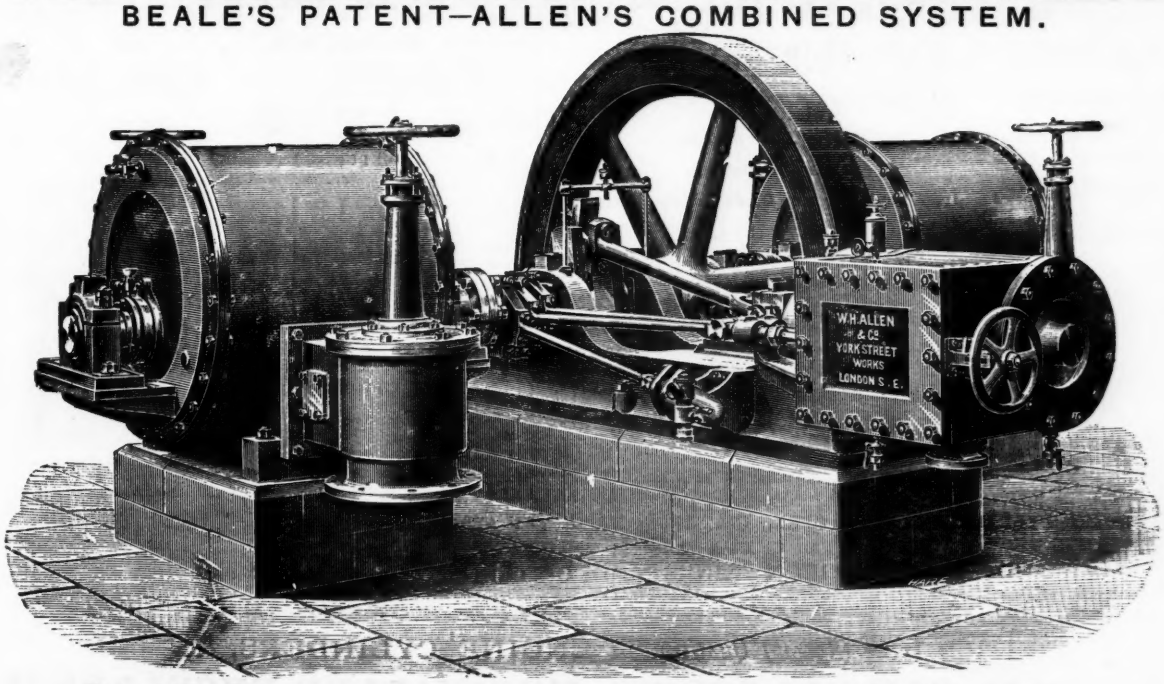

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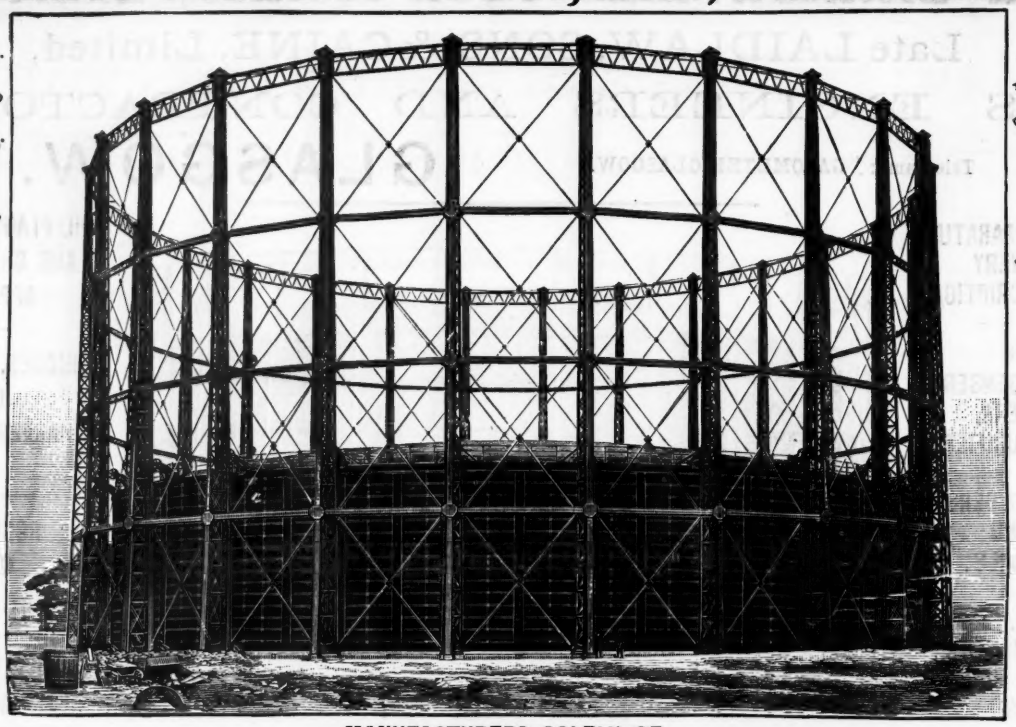

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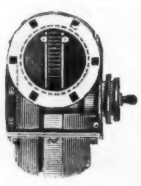

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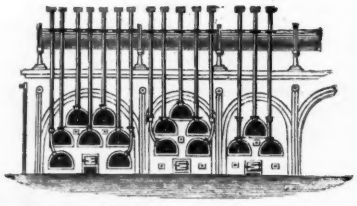

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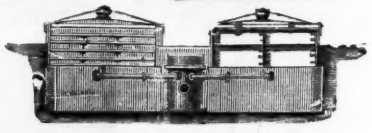

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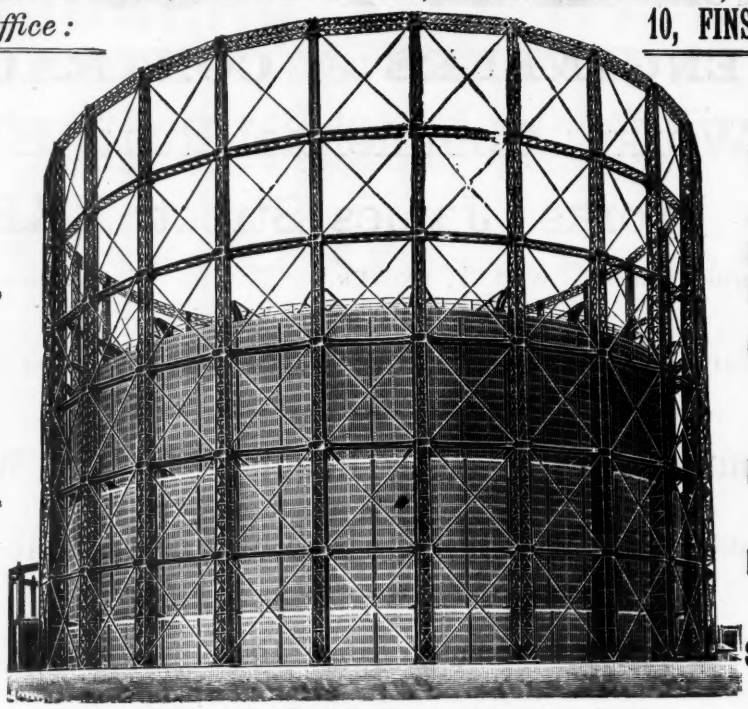

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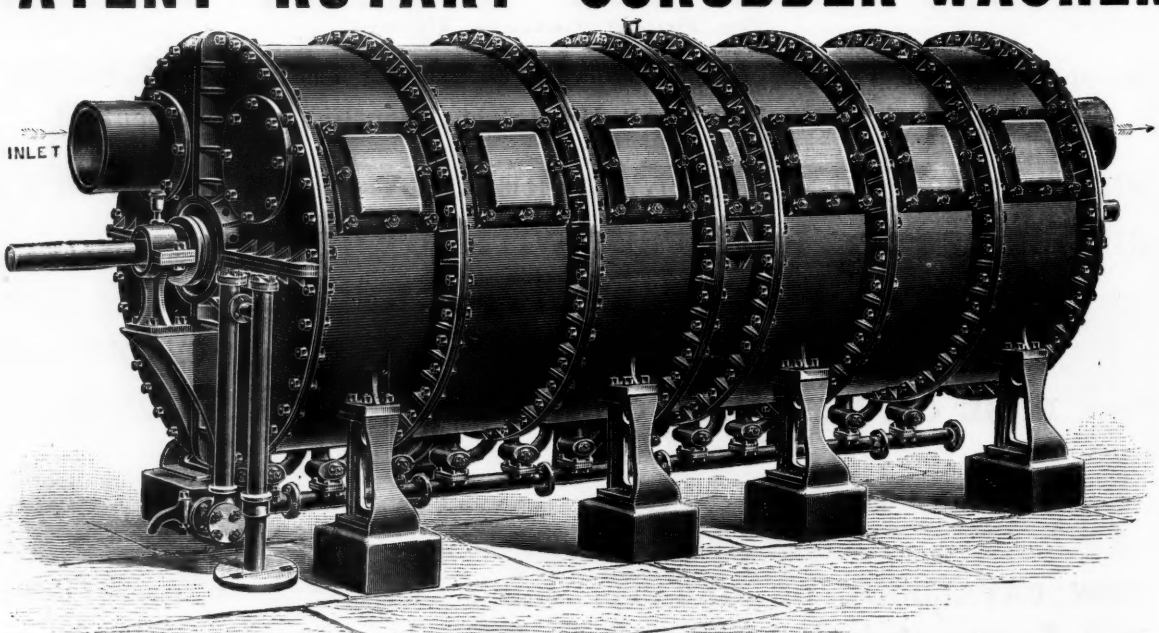

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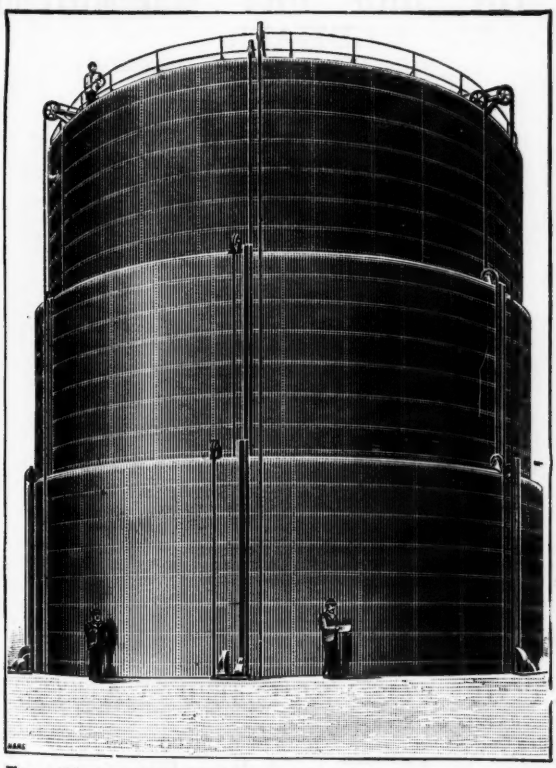

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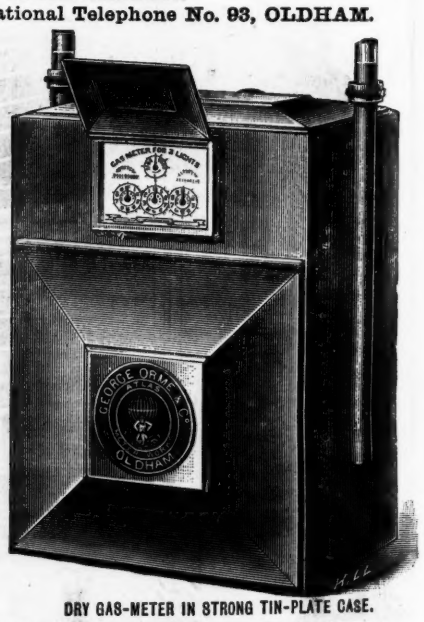

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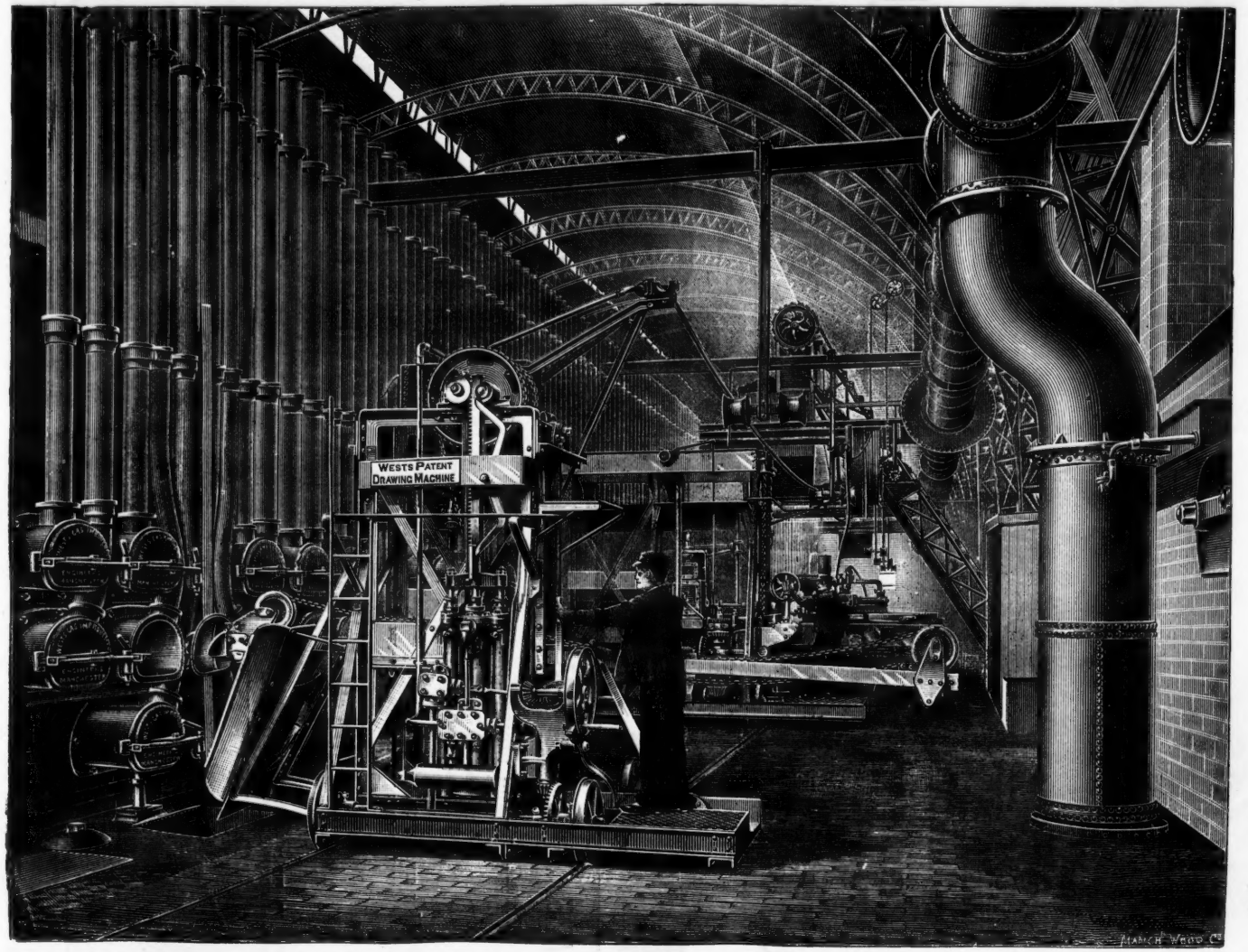

Interior of Retort-House at the Bradford Road Gas-Works, Manchester, showing the Compressed-Air Drawing and Charging Machines.

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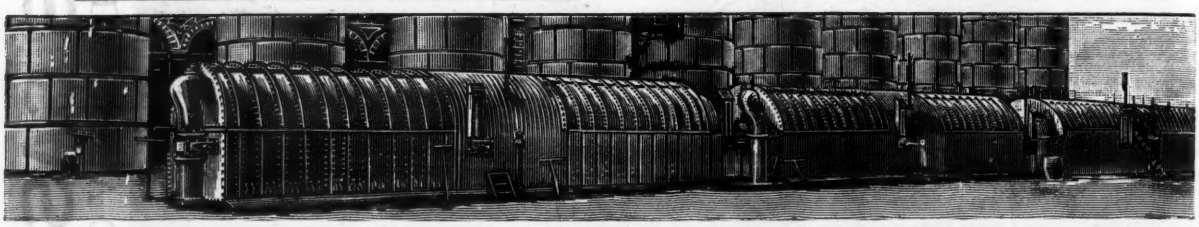

View of SIX PATENT "STANDARD" WASHER-SCRUBBERS, erected at the Beckton Station of The Gaslight and Coke Company (the Engines driving same being under Galvanized Iron Covers). This Company have 30 of these Machines in use. They are also in operation at a great number of Gas and other Works in this Country and Abroad.

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This apparatus being made in sections, the capacity can be easily and cheaply made proportionate to increased make of Gas. Other advantages are: Large and effective cooling area on small ground space, slow speed, no repairs required, high strength liquor obtained, &c.

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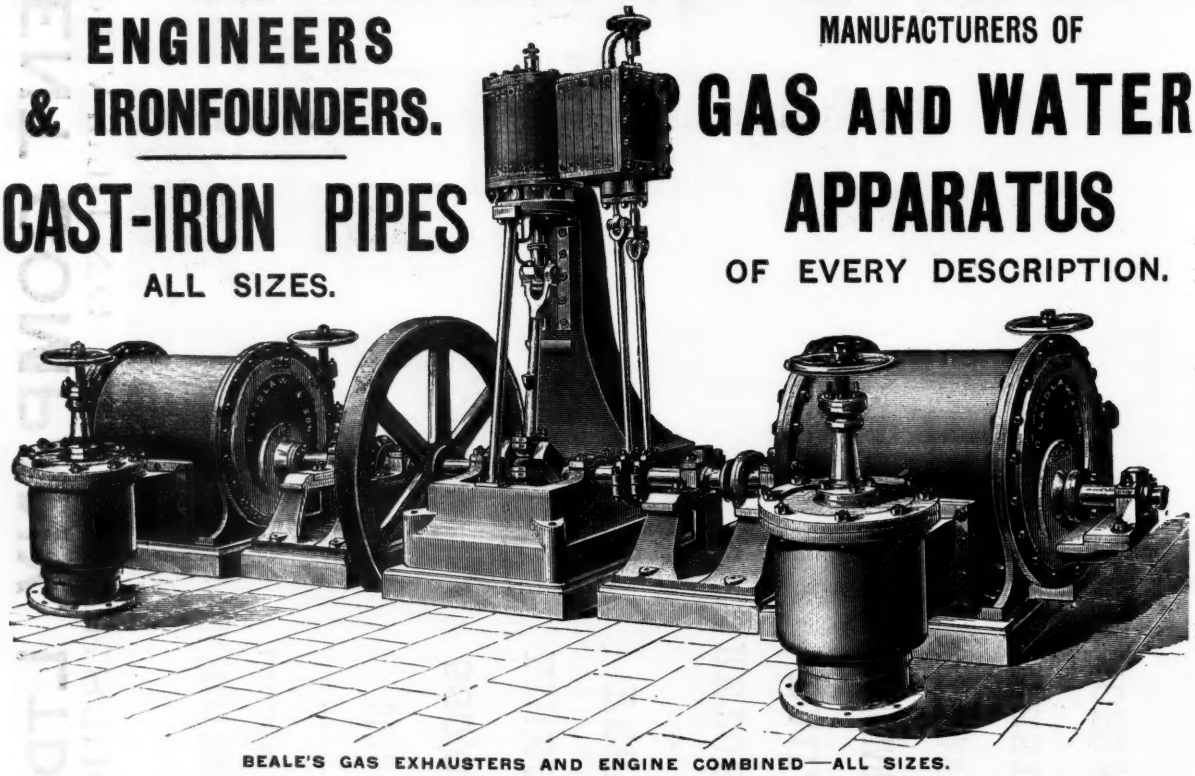

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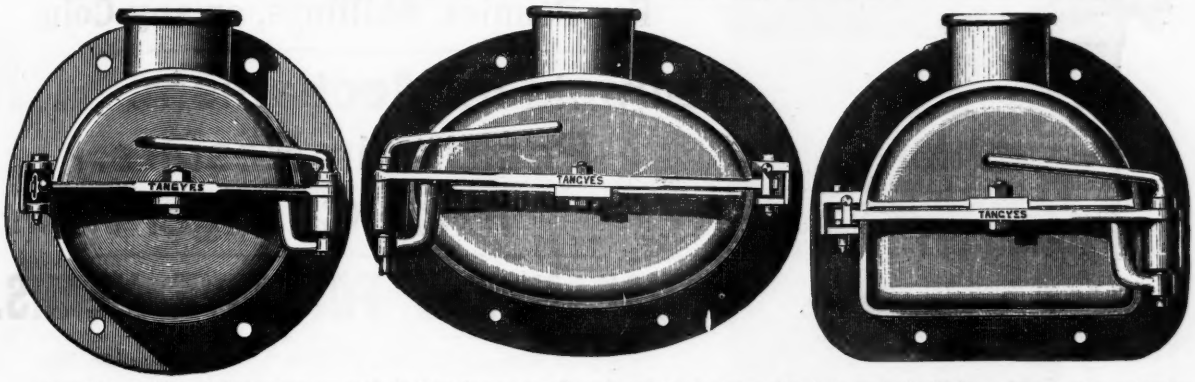

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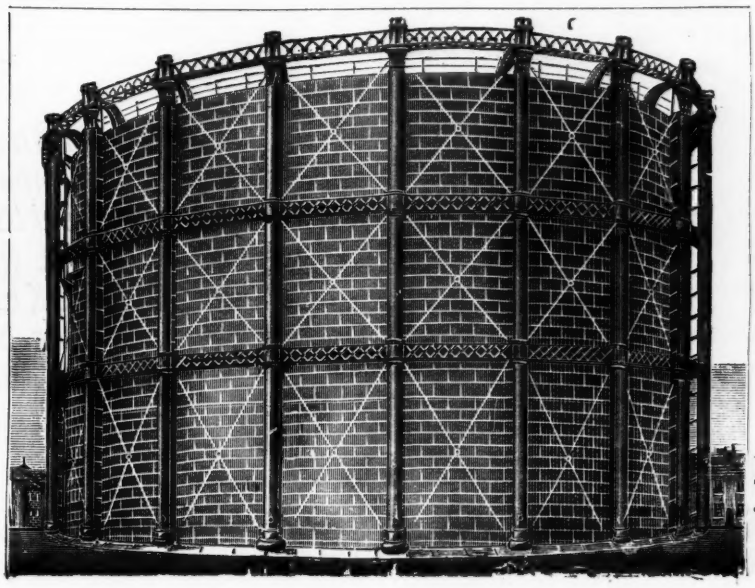

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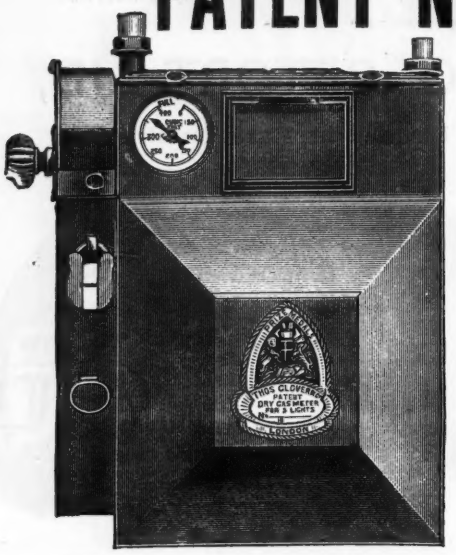

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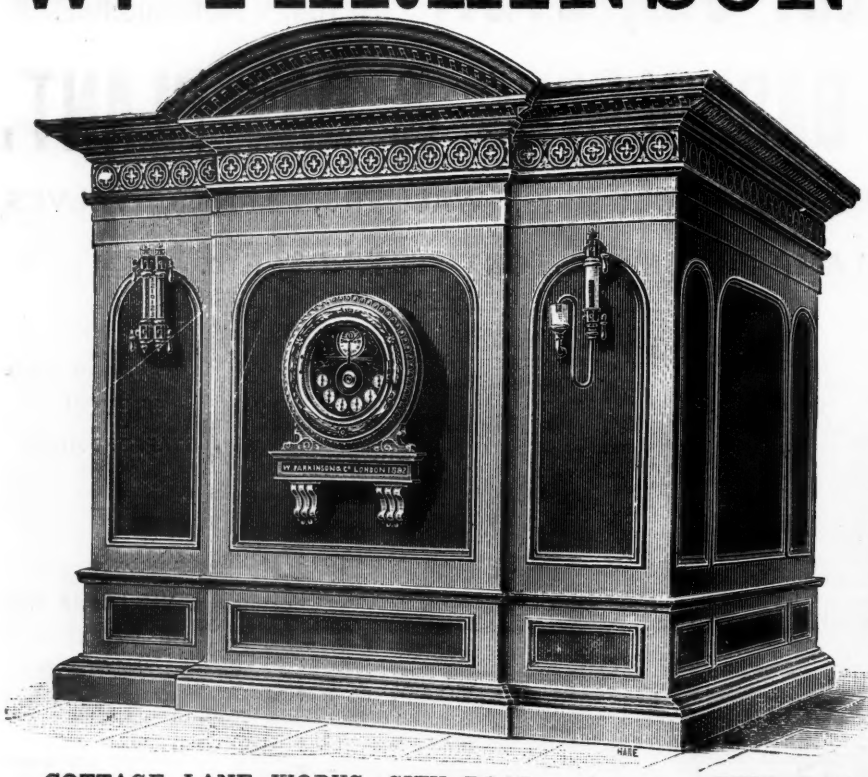

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TO CORRESPONDENTS.

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EDITORIAL NOTES.

The Meeting of the Institution of Gas Engineers.

THE meeting of the Incorporated Institution of Gas Engineers last week cannot be described otherwise than as an unqualified success in every respect. The attendance was good; the papers, as a rule, were excellent; and the discussions were pointed and business-like. If anything, hardly sufficient time was allowed, by the exigencies of the *agenda*, for fully threshing out the very momentous questions raised by the more debateable papers. But if, upon further reflection, anybody wishes to clear up points left in obscurity, our columns are open for the purpose; and we shall be willing at any time to place at the disposal of correspondents every facility they may need for the publication of diagrams and tables elucidatory of their views. Before saying anything more about the meeting, we desire to acknowledge, in the fullest possible manner, the high personal qualities displayed by the President—Mr. C. C. Carpenter—in the discharge of the duties of his position. Mr. Carpenter's address, which appears in another column, was just such a non-rhetorical, calmly-reasoned, and practical essay on points of gas-works management as might have been expected of the author. If it errs at all, it is perhaps in the observance of an excessive reticence in regard to the President's own contributions to the improvement of gas-works construction and administration. But, situated as Mr. Carpenter is in the Metropolitan gas hierarchy, this modesty is both intelligible and excusable; for it is not easy at all points to separate out the individuality of a member of the staff of a great gas undertaking from the polity of which in many respects he must be content to be an expression. Where, however, Mr. Carpenter stood for himself last week, he was found more than equal to the demands made upon his tact, good sense, and professional repute.

In at least one matter—not by any means a small one—Mr. Carpenter set a good example to the holders of similar positions. He tacitly ignored the old-fashioned custom that the President of a congress of technicians should always sum up the points of a paper and the heads of the discussion upon it, and pose as a sort of arbiter between an author and his commentators. So when, during the proceedings of Wednesday and Thursday, Mr. Carpenter felt that he had anything special to say respecting a matter under discussion, he said it in a perfectly natural and unembarrassed way; but when he had nothing to contribute, he held his peace. While maintaining thus by example, and enforcing when necessary by a gentle exercise of his authority, a high standard of relevancy and pointedness in every discussion, the President consistently refrained from standing between the authors of papers and their critics in the amiable, but not seldom irritating, fashion into which occupants of the chair at technical meetings are prone to fall. Presidential loquacity is apt to become a wearisome infliction at public meetings where the clash of many wits, rather than an exhibition of one, is the main object to be attained.

With regard to the papers read at the meeting, we need only remark here that we shall probably have more to say of most of them when they have appeared in print, and a little time has permitted of digestion of their varied subject-matter. It is not fair to authors who have devoted much time and thought to the preparation of communications by which their professional reputations may gain or suffer, to pronounce upon the merits of such compositions according to the first impressions made upon an audience, much of which depends upon the accidents of style and presence. Some papers appear to have been subjected, by authority, to a process of editing which took the authors by surprise, and led in certain instances to little inconsistencies between the readers' words and the text. But we can help the Council here by suggesting that editing is, in the generality of cases, essential, and that authors have it in their power to avoid surprises by being early enough with their manuscripts to enable prints to be revised betimes. While not pretending to anticipate what will be the final judgment upon the papers of the year by those who will in due course study and weigh them, we may observe, for the guidance of readers of our reports, that, apart from the productions of "past masters" like Mr. George Livesey, Professor Lewes, and Mr. Lewis T. Wright, the papers

of Mr. F. D. Marshall, Mr. A. E. Broadberry, and Mr. T. Holgate appeared to arouse the greatest interest as dealing with fresh and instructive matters.

It is with considerable satisfaction that we record the promise of the continuance of the autumn meeting of the Institution. Next time, the meeting is to be in Liverpool, by invitation of Mr. William King. This notification should be enough to induce every member of the Institution to register a mental vow "to be there," circumstances permitting. It is, we are fully assured, impossible to exaggerate the utility of these periods devoted to the friendly intercourse of professional men having a common interest, and acknowledging a fraternal bond under which they are able to speak their mind concerning what is uppermost in their thoughts. This was well seen during Friday's excursion to Brighton, when Mr. R. J. Billinton, the Locomotive Superintendent of the Brighton Railway Company, conducted the party over the engine and carriage works of the Company, and Mr. J. Cash, the Engineer of the Brighton and Hove Gas Company, received and entertained the visitors at the Portslade Gas-Works. Favoured by magnificent weather, the trip was a great success; and if the opportunity incidentally afforded for fraternal converse was not, as one member described it, "worth all the papers put together," it was certainly a good example of a function which the manageable proportions of the Institution, and the unity of spirit among its members, combine to render extremely useful and enjoyable.

The Report of the Standards of Light Committee.

THE report of the Board of Trade Committee on Standards for Testing the Illuminating Power of Coal Gas has been presented to Parliament; and it is given elsewhere as an appendix to Professor Lewes's paper on the work of the Committee, read at last week's meeting of the Institution of Gas Engineers. It would have been sufficient of itself to distinguish this gathering, that it was made the occasion of the first publication to the world of a paper of such importance. We have been accused of making querulous remarks upon the dilatoriness of the Committee in bringing their protracted labours to an issue; and we admit that there has been an uneasy suspicion abroad that the inquiry might prove fruitless after all. We gladly avail ourselves of the first opportunity that presents itself for acknowledging the fact that a report, and a practically unanimous one, has appeared; and we hasten to express the opinion that it is a statement which will command the respect, and secure the approval, of the vast majority of those who are interested in the subject of which it treats. While not giving all that some experts could desire to find in an authoritative pronouncement on standards of light, and on the best method to be followed in ascertaining the illuminating power of coal gas, the conclusions of the Committee are nevertheless of great practical value, and will form an acceptable basis for prospective legislation.

With the equally important subject of photometers and their uses, the Committee were powerless to deal; and we cannot find it in us to deplore the fact, because such an extension of the Committee's labours would probably have led them into embarrassments beyond the possibility of deliverance. As it is, having secured an agreed standard, the further probability is that the settlement of gas photometry upon a uniform instrumental system will not be found impracticable by means of a Bill in Parliament which would come before an ordinary Committee. Mr. Hunt has lost no time in making his protest against what he regards as the failure of the Committee to do full justice to gas under the conditions of a test for illuminating power. But it is explained by Professor Lewes that the decision arrived at by the Committee in this regard was the best that could be had in the circumstances. The Committee, in effect, declare that they have found some things, and they recommend others. Their findings are that the flame of the actual parliamentary sperm candle does not furnish a satisfactory standard; and that, since it is desirable that the standard should be some light of combustion and of the nature of a flame, Mr. A. Vernon Harcourt's 1-candle pentane standard answers the initial requirement of an unvarying, readily-producible equivalent of the candle. They also find that, for practical use in gas testing, the Dibdin 10-candle pentane Argand is the best available standard; and accordingly this is the appliance they recommend for sealing and issue as the authorized and prescribed standard "for official use in testing the illuminating power of the gas supplied by the London Gas Companies." So far, all is plain sailing; and we are able to congratulate both Mr. Vernon Harcourt and Mr. Dibdin upon the success of their public-spirited efforts to produce, by combining their own initiative with the results of the labours of others in the same field, a workable and reliable standard of light worthy of being commended for parliamentary sanction.

Whatever may be their future fate, the 1-candle standard and the 10-candle standard are actualities belonging to the accepted appliances of modern civilization. These standards are universally approved of by the gas engineering profession—the first, as showing what a standard candle really should be as a light; and the second, as a convenient value of the standard for use in practical gas testing. When, however, we come to consider Mr. Hunt's pertinent question: "What is 16-candle gas?" we enter upon debateable ground. The Committee, in the last clause of their report, recommend that, while the illuminating power of coal gas shall continue to be expressed as heretofore in terms of the light given by 5 cubic feet of gas burnt per hour from the standard "London" Argand burner, the present requirement that, in testing, the gas shall actually be consumed at this rate, should be rescinded. In substitution for this, it is advised that the gas shall be burnt at whatever rate is found necessary in order that it may give a light equal to that of the prescribed number of candles, the illuminating power being then "calculated as being inversely as the rate at which such gas had to be burnt during the testing so as to give this amount of light." This is not what was asked for by the joint deputation from the Institution of Gas Engineers and the Gas Institute which had an interview with the Committee with the object of making certain suggestions. The report of the interview is fully given as an appendix to the report. Instead of the hard-and-fast 5-feet rate of burning, the deputation asked in effect that the gas should be burnt from the test burner so as to fill the chimney with its flame, when it would be developing its maximum luminosity. In the result, the Committee have abandoned the 5-feet rule, but have adopted in its place the principle of the Paris system, in which the amount of light yielded is fixed, and it is the rate of consumption which is variable. Instead, however, of fully carrying out the French method of stating the quality of gas in terms of the rate of consumption required to produce the fixed lighting effect—to which, indeed, our system of cubic measure does not lend itself so easily as does the metric—a further calculation is to be made to show what the result means in terms of candle power. The French say of gas quite naturally that it is gas "of 120 litres," gas "of 140 litres," and so on; meaning that it takes the named rate of combustion per hour from the standard burner to yield the light of the standard Carcel lamp. We could not talk of gas in the same way here, not only because to do so would involve a radical rearrangement of ideas about gas testing, but also because it would be necessary in this case to introduce into the statement fractional rates of consumption, whenever it was not exactly "5-feet gas" that happened to be in question. Professor Lewes has explained that, while the alteration recommended by the Committee does not give to rich gas all that Mr. Hunt's favourite plan would show, it distinctly helps a poor gas which happens to be perilously near the point of penalization.

It only remains to acknowledge the services of the members of the Committee, and in particular the labours of the Chairman (Dr. Odling) and the Secretary (Professor Lewes). The thanks of the gas industry and of the community are due to these indefatigable and devoted workers in an obscure field wherein no honours are to be gleaned, and only the inward satisfaction of having faithfully performed a tedious duty remains to reward the toiler.

Meter-Rents in the Metropolitan District.

A CURIOUS little return made by order of the London County Council as to the meter-rents charged by the Gas Companies within the Metropolitan area appears in another column, and supplies a few suggestive facts for gas-works administrators and their would-be reformers. Possibly moved by the remission of meter-rents by The Gaslight and Coke Company, the London County Council seem to have concluded that, if they could not compel all the

other Companies to follow suit, they could, at any rate, look into the charges all round, and see if these were within the statutory rights of the respective undertakings. The Council accordingly referred the matter to their Public Control Committee, to inquire into and report upon. This Committee state that they are advised that by the Metropolis Gas Act, 1860, the rent is restricted, as regards meters not exceeding 5 lights, to 10 per cent. on the cost of such meters, with no statutory limit in respect of larger meters. Taking the price-list of a well-known firm of meter-makers in London as their source of information as to the cost price of these articles, the Committee have discovered that a 3-light meter will bear a 10 per cent. rental of 3s. 6d. per annum; and a 5-light meter, 4s. 6d. per annum. The South Metropolitan Gas Company charge 3s. per annum for one size, and 4s. for the other; the Commercial Company, 2s. and 3s. 4d. per annum respectively. Obviously, therefore, both these Companies are well on "the windy side of the law" in this regard. When the Committee came to look up the charges of the Wandsworth and Putney, the Crystal Palace District, and the Brentford Companies, they appeared to discover several inconsistencies. The first-named Company have low meter-rents; the second has but one uniform rate of 3s. per annum for all sizes; while the Brentford Company must be admitted to be dear, with a rate of 6s. for both 3-light and 5-light meters. Since, however, these undertakings do not come under the provisions of the Metropolis Gas Act, 1860, the Committee cannot see their way to offering any suggestions. It is quite true that there is no statutory limit of the rate of hire of gas-meters applicable to gas-companies generally; the Gas-Works Clauses Acts, 1847 and 1871, agreeing in requiring only that the rental shall be such "as may be agreed upon" between the hirer and the undertakers. It is evident, however, that an agreement in such a case is an essentially one-sided affair. The Company fix and prescribe the rate, and the consumer has either to consent to pay it or go without gas. There is no such free bargaining here as seems to be implied in the phrase "agreed upon between "the parties." There is not even the usual saving clause for determining the amount of the meter-rent by reference, in the event of disagreement, to an arbitrator or to two Justices. The latter procedure comes in to settle the amount of the security which may be demanded for payment of the hire of the meter, but not in regard to the amount of such hire. This is archaic. Gas Companies usually act in a reasonable way in fixing the amount of meter-rents; and those are to be commended who put the charge, where it exists, at no more than is sufficient to clear expenses. There can be no justification for making a profit on meter-rentals. Gas companies occasionally get into a way of allowing charges such as this to run on as they were settled in the early days; but the practice is not to be commended. It is to be hoped that, now the London County Council have drawn attention to the subject, any suburban or other company who are behind the times in this regard will take an opportunity for assimilating their charges to those of more advanced contemporaries.

An Artificial Lighting Census.

An interesting report on the use of artificial light in the town of Dukinfield has been presented to the Urban District Council by Mr. Harrison Veevers, the Engineer to the Gas Committee of this body. It is an example, as will be seen by our reproduction of it in substance in another column, of what may be done by a careful observer who will take the trouble to treat a town as a distinct organism, and ascertain, among other things, how it lights itself. In December, 1886, a similar report was prepared by the same hand, to which the statement now under notice must be read as a supplement. The first impression created by the work of Mr. Veevers is one of disappointment at the comparative lack of development of gas consumption during the past nine years. The prepayment meters have just saved the situation; as, but for 135 of these appliances fixed this year, the percentage of householders using petroleum would have been actually greater than it was nine years ago. The reasons for patronizing illuminants other than gas collected by Mr. Veevers are in some cases amusing. In three instances, quarrels between consumers and gas officials, twenty years old, have served to keep gas out of favour during all this time. Mr. Veevers is determined to make an effort to recover lost ground; and, as he shrewdly says, now is the very time to take action, with gas coming down and petroleum going up in price. Gas manufacturers will be more effete than they would like to be taken for, if they do not turn the recent "boom" of petroleum to some advantage. It is all very well to call gas a "monopoly;" but those who do so may be reminded that, in the sale of a statute-regulated commodity like gas, there can at least be no "rigging the market." We heartily commend such investigations as those instituted by Mr. Veevers. They have paid for making, in his case; and when considerately made and the results properly treated, they can hardly fail anywhere to repay the expense and trouble involved in carrying them out—always supposing, of course, that they are not resolved upon merely as a kind of census-taking, but are intended for use as a starting-point for a forward policy in the popularization of gas.

WATER AND SANITARY AFFAIRS.

To-day the Hybrid Committee to whom certain of the London Water Bills have been referred, will commence their consideration of these measures. The Bills with which they have to deal at present are two out of the eight Transfer Bills of the County Council, and the Bills which are promoted by the Lambeth and Chelsea Companies—these latter proposing the raising of additional loan capital. The Committee have elected Mr. Plunket as their Chairman; and it is expected that they will proceed in the first instance with the Bill proposing the transfer of the Lambeth undertaking. Arrangements have been made for sitting three days in each week. But the inquiry opens late in the session; and the Committee have a vast amount of work to get through, supposing the whole of the eight Transfer Bills come before them—an event which cannot take place until after June 13. Mr. Stuart, acting in Parliament on behalf of the County Council, pleads that he has pursued one unvarying policy concerning the Transfer Bills; having stated distinctly, when the second reading of the Chelsea Transfer Bill and the five others was postponed from Feb. 28 to May 3, that he should move for a further adjournment if the Lambeth and the Southwark and Vauxhall Transfer Bills were still under consideration at the latter date. We are willing to allow that Mr. Stuart has been perfectly consistent in his mode of proceeding; but then we should like to know the meaning of it. Not only are six out of the eight Bills unaccountably held over, but the two Bills which are allowed to block the way have been themselves delayed in a most singular manner. If the second reading of the two Transfer Bills in question had been postponed until sufficient time had elapsed for the newly-elected County Council to decide on the propriety of going on with such measures, there would have been reason in the delay. But the interval prescribed was longer than necessary for such a purpose, besides which there was the avowed determination on the part of the Progressives to allow of no change in the attitude of the Council on the water question. From their point of view, there was no need to wait for any further decision. Why, then, was the second reading of the two Bills postponed for two months? The only reason given has been a statement by Mr. Stuart, that he thought May 3 was the earliest possible date at which the second reading could take place. Why Mr. Stuart thought so does not appear. Now again Mr. Stuart's coach stops the way until June 13; and, to make matters worse, the two Water Bills which have nothing to do with the transfer question, and which were originally intended for consideration by a Select Committee in the usual manner, are now referred to the Hybrid Committee. The result is chaos; and we should like to know whether the County Council would prefer to see the Transfer Bills upset, so that they might have a clear course to come before Parliament next session with a scheme based on the costly and unnecessary expedient of an entirely new water supply. It seems scarcely possible for the Transfer Bills to be dealt with in the present session; and the County Council have themselves aggravated the difficulties of the situation. The character of the Bills, apart from any other cause, is a sufficient obstacle to their progress, owing to the extraordinary conditions which they involve, as we find well set forth in the petition from the New

River Company, an epitome of which is published in another column. Opposition presents itself on every hand; and, among the rest, the Hampstead Vestry have resolved to petition against the Transfer Bills relating to their district, at the same time laying down the terms of what may be styled a model water supply of the Utopian type. It would be interesting to know whether the County Council are prepared to concede all the "points" raised by the Vestry of Hampstead.

The question of the outer areas in relation to the water supply of the Metropolis, as affected by the Transfer Bills of the London County Council, is assuming an acute phase in that part of the Kent Company's district which lies "over the border." This outer area, as shown by General Scott in 1890, comprehends 147 square miles; having, at the close of 1889, a population exceeding 93,000. As the total population then supplied by the Kent Company has since been increased by about 52,000, we may reckon that the population of the outer area is now considerably more than 100,000, subject also to a particularly rapid augmentation. The Local Authorities of this area, evidently feel it their duty to protect the water supply of the district from being appropriated by the London County Council. Hence, though it seems a little after date, they are endeavouring to unite for the purpose of bringing a scheme before Parliament next year, for the creation or adoption of some authority which shall act as a Water Trust or Water Board for the district. Three eminent engineers who have prepared a report on the subject, suggest that the works of the Kent outer area should be acquired and managed by a Joint Water Board, to be elected by all the Local Authorities concerned. It will be seen that Sir J. Farnaby Lennard, who is Chairman of the Kent County Council, favours such a plan, though he also suggests something which would seem to give the supreme control to that Council. Beyond doubt, he is emphatic in denouncing the "absorption policy" which characterizes the Transfer Bills, and declares that the project thus brought before Parliament would be "absolutely ruinous" to the West Kent district. There is now a prospect that the Kent County Council will oppose the Transfer Bills, and will bring forward the Water Trust proposal as a counter-scheme. The Kent authorities have a strong case, if they know how to put it. Their water supply has essentially a local source; being derived from wells in their own territory, and not from a river flowing along a course of many miles. There is also the purely extra-Metropolitan character of an extensive area, reaching as far as Dartford and Sevenoaks. But these authorities will have to fight the London Council; and this they must do at once, if they mean to guard against the risk—perhaps rather remote, though possible—of being summarily "absorbed." The Kent County Council will have to stand in the forefront of the battle; and we observe there is a point raised as to the sinews of war, concerning which there ought to be no failure.

It appears from a report of the Parliamentary Committee to come before the London County Council to-day, that an agreement is likely to be entered into with the Surrey County Council as to the terms on which the latter shall acquire, "after purchase by the Council," that part of the undertaking of the Lambeth Water Company which is applicable to the supply of so much of the County of Surrey as is within the Company's parliamentary area.

The Devonport water-rate case, reported in last week's JOURNAL, affords an interesting example of the discontented water consumer being "hoist with his own petard." The actual details of the dispute need not here be discussed. Enough to say that the Devonport Company and Mr. Hugh Shannon, who haled the Company before the local Justices, were at issue as to the proper assessment in respect of Mr. Shannon's premises. It appears that, as long ago as 1886, Mr. Shannon rebuilt his house; and thereupon ensued a dispute with the Company, which ended in a concession on their part as to the rate to be payable in future. That rate Mr. Shannon duly paid up to June 30, 1893, since which date, until the hearing of the magisterial summons, he had paid nothing at all. The complainant seems to have developed further views of a subtle character as to the basis of assessment; and he tendered the collector £1 14s. instead of £1 17s. for a half-year's supply of water. The smaller amount was refused. Hence the deadlock, until the Company's patience being at last exhausted, the water supply was discontinued. Thereupon Mr. Shannon sought to enforce divers pains and penalties against the Company, for refusing to supply him with water during the time for which the water-rate was tendered. On the case coming before the Magistrates, it was very sensibly suggested that a cross-summons should be granted against Mr. Shannon, so as to enable the Justices, pursuant to the general law affecting water companies, to determine the proper amount of the assessment. This course was allowed. Obviously, if the existing assessment was correct, the complainant had nothing to complain of; and, in fact, this was the direct deduction from the proceedings. The Magistrates found the assessment fair and reasonable; and they therefore declined to alter it.

Some of the Provincial Councils must prove extremely troublesome to the Local Government Board. It is not only that the District Councils ask the Central Authority to sanction all sorts of local enterprises, and facilitate new loans on every conceivable pretext, but that they sometimes ask for what the Local Government Board itself has no power to grant. Quite recently, the Gateshead Town Council tried to bring about an official inquiry as to the failure of the local water supply during the winter, and in order that a recurrence of the failure might be obviated. Surely this was a question upon which the municipal wisdom of Gateshead might have been brought to bear without bringing an Inspector down from Whitehall. The Local Government Board would have more than enough to do if it directed inquiries in such circumstances as these. We are not surprised to learn that the effect of the official reply is that the Government Department has no power to order the inquiry suggested at Gateshead.

Another instance of the tendency to put a curb on restless municipalists is to be fonnd in the action of the Local Government Board in relation to the Mexbro' District Water-Works. The Council wanted permission to borrow £3400 for the purpose of making extensions and improvements in the works; but, as at present advised, the Whitehall authorities decline to sanction the loan. As a tentative measure, their sanction will be given to a preliminary loan of a small sum—£200—to enable the Council to make some experiments in boring for water. When that is done, the Council will be required to pump the water continuously for a period of at least two months, and to gauge by means of a meter the quantity so pumped. These are, in themselves, not very important incidents in local government administration; but they are here worth noting as affording some indication of the more cautious policy now adopted at head-quarters when schemes of purchase or extended water supply are entered upon by those who have, or seek for, the privilege of spending other people's money.

Death of Mr. Edwards, of Renton.—The death is announced of Mr. W. Edwards, the Manager of the Renton Gas Company. Deceased was a native of Forfar; and his remains were interred there on the 4th inst. He left a widow and three children.

Mr. William Moult, for the last four years Manager of the Hafodunos Gas and Water Works, near Abegele, North Wales, and formerly seven years with the Stockport Corporation Gas Committee, has been appointed Manager of the Rugeley Gas Company, Limited.

Presentation to Mr. R. Hooton.—Mr. R. Hooton, lately Superintendent at the Lum Street Gas-Works of the Bolton Corporation, has been presented by the workmen with a testimonial—consisting of a marble timepiece and bronzes, Cassell's "Encyclopædic Dictionary" complete, and a purse of gold—on his leaving Bolton to take a better position at Ashton-under-Lyne.

Gas Traction for Tramways.—Our readers may remember that a Company was formed in September last year for constructing and working a line of tramway between Blackpool, St. Anne's-on-the-Sea, and Lytham; the motive power to be employed being gas, on the Lührig system, as used on the Croydon line. We learn that so much progress has been made with the work, that the line will probably be opened some time about the middle of July.

Mr. H. O'Connor, Assoc.M.Inst.C.E., has relinquished the supervision of the constructing work at Beckton, under Mr. G. C. Trewby, and taken the management of the gas-works apparatus department of Messrs. James Milne and Son, Limited, in Edinburgh. Mr. O'Connor's wide experience in this country and abroad should prove of service to him in his new position; and we trust his appointment will result in a considerable accession of business to the old-established firm whose service he has entered.

THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

ROYAL UNITED SERVICE INSTITUTION, WHITEHALL,

MAY 8TH & 9TH, 1895.

Mr. C. C. CARPENTER, Assoc.M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

FORTUNE favoured the Institution of Gas Engineers in the matter of weather last week; for summer appeared to come to London at the same time as the members of the Institution. It was not a large, but a large enough, assembly that greeted the President—Mr. C. C. Carpenter—when he proceeded to take the chair in the new lecture hall of the Royal United Service Institution in Whitehall; and, with no waste of precious time in ceremonial preliminaries, he plunged at once into the reading of his address. There is certainly a great advantage for the general body of members in the arrangement whereby the Institution is enabled to dispose of its necessary, but not very interesting constitutional business at the formal meeting in the early spring; since this clearance leaves those who attend the popular meetings free to make the best and most interesting use of their shining hours.

The presidential address, it may at once be said, is exactly what, in point of character and quality, was to have been expected of a hard-working, observant, and highly-trained Metropolitan Gas Engineer. Mr. Carpenter has the welfare of the Institution so thoroughly at heart, that everybody looked for an address from him that should be worthy of the organization and of himself. The expectation was completely fulfilled. Without any straining after oratorical effect, or attempting to impose his own personality unduly upon the meeting, Mr. Carpenter succeeded in holding the attention of his hearers throughout the whole of the time he took—most pleasantly and profitably—in discoursing of the things which are just now uppermost in the minds of British gas engineers and station managers. It is possible—indeed, quite probable—that a certain section of the wider public which will make the acquaintance of Mr. Carpenter's remarks through the medium of our columns will not relish some of the expressions that occur at the commencement of his address. But this cannot be helped; for when people exercise their freedom of action to subserve their own benefit, others against whom the action is directed are equally at liberty to say what they think about it.

The first technical question touched upon in the address was naturally that of gas enrichment and enrichment methods. While admitting that the necessity of enrichment of any kind and to any extent is both technically and commercially still an open question, Mr. Carpenter is fain to confess that, for the time being, there is only one possible answer to it. Enrichment must be obtained somehow, for the satisfaction of the law and the gratification of the imperfectly-educated consumer; so that the actual problem for gas manufacturers to grapple with is that of ways and means. Mr. Carpenter said a good word for carburetted water gas; and he also performed a real service in discriminating between the case for water-gas making and that for the method of carburetting usually associated with water-gas manufacture. He is impressed with the opinion, probably well founded, that, for use as an enricher of illuminating gas, oil is better retorted according to the Peebles system then when treated directly in the open cupola. His observations upon this head are deserving of careful attention. The mere fact that in the American development of carburetted water-gas processes the oil is sprayed into the cupola, really says nothing for the economy of the arrangement; for the cost of the oil has never been the controlling factor in America that it is, and will ever be, in this country. It is more difficult to agree with what Mr. Carpenter has to say in regard to the feasibility of the idea of making water gas in an ordinary coal-gas retort. The suggestion has often been heard of, and it has been tried in a variety of ways, but never with any permanent good result. The late Sir W. Siemens commended it to the consideration of gas managers; and there is at least a probability that a little steam might be used towards the tail-end of a charge, for sweeping out the last of the gas, and taking up the highest heat of the coke. The quantity of steam that could be used in this way without detriment to the heats would, however, be so small, and its employment would be attended with so much trouble, and demand so much care, that the gain could never be worth securing in so hazardous a way. It would be infinitely better to draw or push the charge out of the retorts into a cupola, and treat the coke there.

The references in the address to mechanical stoking appliances are of a closely practical character; and the same may be said of Mr. Carpenter's weighty remarks upon the subject of Sunday closing, and the arrangements and safeguards whereby this still halting reform may be carried out. It is a curious, and not at all a gratifying reflection, that when the President of a technical society such as the Incorporated Institution of Gas Engineers has to speak about a money-making or money-saving piece of mechanism, like the retort-charging apparatus of Foulis or West, he is called upon to recognize improvement and advance, even though the previous mention of the appliance is only a year old; but when it becomes a question of such a matter as the suspension of Sunday work, there is no mention of progress, but only an expression of regret that things are not better than they are. The motive power in the two cases is so different!

It will be noticed that Mr. Carpenter is in favour of setting back the exhauster as far as possible; making it next in series to the hydraulic main. This means fast running, and has been a debateable question of practice; but the balance of convenience is on Mr. Carpenter's side. A commendatory reference to the use by Mr. Green, of Preston, of canvas as the liquor-carrying material for washers and scrubbers, was reinforced by the circumstance of an "exhibit" of this expedient being on view in the ante-room. It seems strange that such an apparently obvious application of textile material should be noticeable as a novelty. Reference to the purification of ammoniacal liquor and to a point of practice in the purification of gas from sulphur compounds, to unaccounted-for gas, to gasholder design, and to prepayment meters, brought to a close an address which is throughout more practical than controversial. Indeed, there is so little of a debateable nature in Mr. Carpenter's observations, that it is impossible to carry on any discussion upon them to any great length. We do say, however, that the working gas manager who studies the address with an open mind will be likely to find in it something to help him to do his daily duty better, and to assist him in finding a solution for some common difficulties of his calling; and this is probably what Mr. Carpenter would regard as the highest kind of commendation for his presidential pronouncement.

The address was very cordially received; and a well-deserved vote of thanks to the President was moved in eulogistic terms by Mr. Foulis, of Glasgow, and accorded by acclamation. Then came the reading of Mr. George Livesey's paper on "Workmen's Funds for Sickness, Accident, Old Age, &c.," which had avowedly been suggested by JOURNAL articles on the subject. The paper is to be welcomed for its own sake, as well as for the opportunity it supplied for a little—by no means sufficient—ventilation of the matter, from the point of view of the gas manager. It led to the establishment of two facts germane to the general subject—first, the legal one, that there is no violation of the Truck Acts in the insistance upon workmen's contributions to sick funds; secondly, that, while the management of the statutory gas undertakings of the United Kingdom does in very many cases help the working staff to make regular provision for "a rainy day," in more instances this has to be supplemented by the irregular, unsystematic continuance in compassionate employment of worn-out men who had better be otherwise provided for. There are many reasons why the latter practice should give place to some better arrangement; and it is to be hoped that the paper and discussion will contribute to the formation of sounder public opinion in this regard. It has to be admitted, however, that human nature stands for a good deal in the tacit preference of gas company directors and municipal committees for unorganized to systematic efforts to ameliorate the lot of the aged and infirm worker.

Professor Lewes's account of the result of the labours

of the Committee on Standards of Light was one of the great features of the meeting. As we shall have to deal with the Committee's report in another place, we can only say here that the result of the inquiry is as good a solution of the many difficulties of the subject as could have been expected, and better than was to have been feared. The other contribution by Professor Lewes to the Transactions—his paper on "Acetylene and its Enrichment Value," read on Thursday—was noteworthy as a masterly statement of the technical position in this regard. It will materially enhance the author's personal reputation for candour, as well as for thorough knowledge of his subject and ability in exposition. Of the other papers, it is only necessary to say at present that they were, with hardly an exception, of a high order of merit, and gave occasion for much pointed discussion. Seldom has a technical society had so much good work submitted to it for notice and criticism; and rarely has a gas managers' association better employed its time than the Institution did during Wednesday and Thursday last.

Before the meeting closed on Thursday with the usual coruscation of votes of thanks, opportunity was accorded of reconsidering the question of the autumn meeting, in connection with an invitation from Mr. William King to the Institution to make Liverpool the scene of the next gathering of the kind. It is satisfactory to know that there was not a voice raised for abandoning these autumnal functions, which are so pleasant for all who can participate in them. If the number is sometimes small, this is intelligible; and it would be a pity to deprive even a few of a social benefit all would share in if they could. Liverpool is sure to prove a popular fixture.

The excursion on Friday has now, very properly, become an integral part of the programme of Institution meetings; and the least that can be said of such quiet outings as members indulge in is that they are certainly as grateful and valuable in their way as the dinners. A couple of saloon carriages attached to the 10 a.m. train from Victoria took the party to Brighton, where they were first received and conducted over the railway carriage and engine works by Mr. R. J. Billinton, the Locomotive Superintendent, and his assistants. Next the visitors were driven in brakes to the Portslade station of the Brighton and Hove General Gas Company, where lunch was kindly provided by the Directors. After this an inspection of the works was made under the guidance of the Engineer, Mr. J. Cash, and his assistants. These works were briefly described in the official programme of the meeting published in the JOURNAL for the 30th ult. To this description it is only necessary to add that a complete installation of carburetted water-gas plant is being provided for the Company by Messrs. Humphreys and Glasgow. Professional visitors to Portslade are not likely to escape being impressed by the handsome elevation of Mr. Cash's line of retort-houses, by the air of spaciousness that pervades the works, and by the success which has attended the coast-defence work undertaken first to save, and secondly to extend the site.

REPORT OF PROCEEDINGS.

The General Meeting of the Institution was held last Wednesday and Thursday, at the Royal United Service Institution, Whitehall.

Mr. ALFRED COLSON, the retiring President, occupied the chair at the commencement of the proceedings.

ANNUAL REPORT AND ACCOUNTS.

The report of the Council (given in the JOURNAL for the 30th ult.) and the statement of accounts having been received,

The CHAIRMAN said he had much pleasure in moving the adoption of the report. He wished particularly to refer to the paragraph relating to the "Index" compiled by Mr. Cripps. Mr. Cripps's contribution to the Transactions of the Institution was of the most valuable character; and they all felt highly indebted to him for the very great pains and labour he had taken in connection with that work. He (the Chairman) could assure him that his work would be greatly valued and appreciated by the gas industry generally. The members would all be pleased to learn from the report that the Photometric Standard Committee had now finished their labours, and that the meeting was to have a record of their work from the able hands of Professor Lewes. This long-vexed question of a standard had now been settled; and he believed it would prove satisfactory to the consumers as well as to the producers of gas. They would all feel that the gas industry was under great obligation to the South Metropolitan Gas Company for having made such a work possible. With regard to the accounts, the balance had slightly decreased; but this had arisen from increased expenditure.

The motion was carried unanimously.

NEW MEMBERS AND ASSOCIATES.

The SCRUTINEERS reported that the following gentlemen had been admitted into the Institution:—

MEMBERS.

Drory, L., Gas-Works, Berlin.
Gray, C. H., Gas-Works, Haarlem, Holland.
Hayman, A. F. P., Gas-Works, Kockelberg, Brussels.

ASSOCIATES.

Sayner, G. S., Gas-Works, Harrogate.
Wright, J. C., Gas-Works, West Ham.

Mr. Colson then vacated the chair, which was taken by Mr. C. C. CARPENTER (Vauxhall), the new President.

THANKS TO THE PAST-PRESIDENT.

Mr. G. C. TREWBY moved a hearty vote of thanks to the retiring President. He said that while Mr. Colson had occupied the chair, the Institution had not suffered; and those who were present at the meeting last year fully appreciated the kind and hospitable manner in which he entertained them.

Mr. CHARLES HUNT seconded the motion; remarking that not only had the Institution not suffered, but it had decidedly augmented in usefulness under the presidency of Mr. Colson.

The vote having been accorded by acclamation,

The PRESIDENT delivered the following

INAUGURAL ADDRESS.

To adequately convey my deep sense of the honour you have conferred in electing me to the presidential chair of this Institution is, I fear, a task beyond my powers of expression. Yet I should indeed be as ungracious as ungrateful were I not to preface this address with some acknowledgment, however brief, of my indebtedness to you for this special signification of that kindness which has ever been extended to me at the hands of all my *confrères*. If this satisfaction is tempered with regrets, they are such as will be shared not less by you, who have the success of the Institution so thoroughly at heart, than by myself, who can, at best, be but a poor substitute for one whom we have long learned to regard as the acknowledged head, as he certainly is the undoubted leader, of his profession.

Founded in 1890 to meet a keenly-felt want—the untrammelled intercourse of the responsible workers in an industry ever growing in magnitude and importance—this Institution has in the past five years amply justified both its existence and its promise. No one can have closely followed the progress of events throughout, but especially during the later portion of this period, without being impressed with the paramount necessity of guarding against the exploitation of individuals, no less than undertakings, by those whose business it is to make the most out of both. An institution which relegates such to the opportunities for fraternization afforded by their own combinations and trade associations, may fairly claim to merit the increasing favour with which it is regarded, and the widening support which is accorded to it by the members of that profession for whose benefit it was founded.

The extension of the "ring" system of supply to the requirements of gas undertakings is, indeed, a fact which cannot be regarded with complacency, still less can it afford to be ignored by those responsible for their good management; and there are satisfactory signs that the stand which has been made against so obnoxious a system has already been productive of good effect. At least one association has lent a favourable ear to the proposal that the prices of their wares should be regulated by a sliding-scale, based upon certain standards of materials and labour which should, from time to time, be determined in conjunction with the Council of this Institution, whose independent representation of the purchasers' interests

would be unquestioned. Yet another combination is already tottering to its fall under the combined stress of internal disagreement and outside competition; while as regards a third, it may be confidently hoped that the salutary example of the South Metropolitan Company, in refusing consideration to tenders for a recent extension emanating from any who could not declare themselves free from the shackles attaching to the worst "ring" of all, will be widely followed, and have good results.

Of gas companies it may be truly said that *Vivo et vivas* is the guiding motto of their dealings with others; and it is certainly in the highest degree unwarrantable that they should have been singled out as victims of the rapacious. Gas supply holds its high position among the necessities which modern civilization has evolved, essentially by its adaptability to the wants of the many; and, to still fill these, it must be supplied under conditions as nearly akin to those pertaining to ordinary business competition as is possible with an industry which can only, and must always, be effectively worked as a so-called monopoly. That the use of gas may go on extending and widening, it is imperative that it shall be sold as cheaply as possible. To do this, the fullest economy must be exercised in the purchase of both raw materials and plant for its manufacture and distribution—in other words, that cheap coal, cheap ironwork, and cheap firework must be obtainable. Fortunately for themselves, gas undertakings are now in competition; and those by whom they are conducted are, without doubt, fully alive to the importance of buying in the most favourable markets. Should these be closed to them, their own almost unlimited resources will permit the creation of manufactories for their plant, and the opening up of independent sources for supplying the raw material they may require.

One of the most important of these automatic displacements by reason of high prices has been the largely increased substitution of oil for cannel coal. The Transactions of this Institution bear eloquent testimony to the position this question has attained in the minds of gas engineers; and it is interesting to remember that the first official visit paid by its members was to an installation of plant for enriching by means of oil, primarily introduced into this country by our first President, Mr. G. C. Trewby. The question has, however, arisen: "Why enrich at all, either with oil or cannel?" and some of the most able of advocates have stated their reasons for the adoption or rejection of such a view. The matter is less one of sentiment than of economic considerations. Gas undertakings are fully alive nowadays to the requirements of their customers without the necessity for their enforcement by Act of Parliament, and can be depended upon for supplying them with what will best satisfy, at the lowest rate taking local the considerations fully into account. It is conceivable, for example, that oil as well as cannel might rise so high in price that the consumer would have to pay very dearly for (say) 17-candle gas; and in this case it would certainly be to his advantage, as was so ably pointed out by Mr. George Livesey, that he should have the opportunity of purchasing lower-quality gas at a proportionally lower rate. We may, indeed, even go so far as to imagine some coincidence of circumstance under which an arrangement of this kind would be imperative in the consumers' interests; as, for instance, a coal and oil famine, and the production of a cheap and stable incandescent burner. As it is, however, there appears some consensus of opinion that oil enrichment, either by the Peebles process or by carburetted water gas, may be effected at a cost under ¼d. per 1000 cubic feet. In these circumstances, and remembering the handle which would be made of any "reduction of standard" by unscrupulous agitators, it may be better for the present to turn our attention to the most profitable methods of using oil as an enricher.

Of the many claims made by the advocates of water gas on its behalf, the greatest is rarely accorded it as an enriching agent. The facility of increased production at will, the independence of the plant from labour conditions, its compactness, and its beneficial effect upon the coke market, are matters of the highest import. But they can be readily disassociated and considered separately from the enrichment *per se*, or the enrichment duty of the oil used. Consideration may be given to this point in the form of apparatus almost wholly in use in England at the present time. Oil, previously preheated, is sprayed into a carburettor—a vessel filled with brickwork—which has been raised to a red heat by the waste gases evolved in "blowing up" the generator or producer of water gas pure and simple. The oil vapours are then carried forward by the incoming current of water gas into a second vessel, similarly heated, in which they are fixed, and the production of carburetted water gas is completed. The carbon deposited upon the checker-work is burnt off during the next "blow." So that this oil gas is formed intermittently by injecting oil into the first, and passing its vapours through the second, of two vessels, which are heated up for each production, and cooled in the process thereof.

It will probably be allowed that, considered purely as an oil-gas producer (as is perfectly justifiable), such a method of procedure cannot claim to be the most scientific or the most economical, especially where variations occur in the quantity or the quality of the oil to be gasified. In the Peebles process, the carburettor and superheater are replaced by a retort which can be readily maintained at any required temperature, and into which a stream of oil is continually flowing. From the retort the evolved vapours pass forward to an oil scrubber, which allows the permanent gas to pass on; while the condensable portions are washed down, and flow back to the retort. The action is a continuous one; the resultants being permanent gas and also the fixed carbon, which is left behind in the retort, and commands a ready sale at good prices. The whole process is, indeed, a far more satisfactory one than is followed for the carbonization of coal; and it is not be wondered at that the maximum of oil duty is obtained. The plant required is extremely simple—comprising a bench of iron retorts, a scrubber, and an oil-tank; no machinery other than a pump being required. Varying qualities and quantities of oil can be readily handled by altering its speed of flow through the retort; and the entire apparatus is such as readily lends itself to the enriching requirements of any sized works producing not only coal but water gas.

The manifest advantages of water-gas plant do not depend upon the manufacture of illuminating gas; and it might perfectly well be enriched by an oil-gas process. More than one benefit would accrue thereby. To begin with, the demands for coke and gas do not vary at the same time, nor proportionately. Many gas-works do not produce sufficient coke in summer for their customers; and, on the other hand, the supply in winter frequently exceeds the demand. In the winter, too, gas requirements are at their highest; and it would therefore appear that water gas should be made at that period on a larger scale than purely for coal gas enrichment purposes. The Peebles 96-candle oil gas would furnish the necessary candle power. Mr. Glover states that at St. Helens not a single lamp was stopped with naphthalene during the late severe frost, which points the justification of using a larger percentage of oil gas in the winter season of the year. In the summer, on the other hand, it will be uneconomical to convert any coke whatever into gas; and therefore the oil-gas plant will be alone in use for bringing up the coal gas to the desired standard.

But another important gain in making uncarburetted water gas has yet to be stated. That water gas can be produced upon a more limited area than is required for coal gas is undoubted; but as regards purifying area, its wants are considerably greater. The percentage of carbonic acid which it contains is normally between 4 and 5 per cent.; but this quantity may easily be exceeded. It goes without saying nowadays that it pays to take out carbonic acid, though the matter becomes more serious when so large a percentage has to be dealt with. Uncarburetted water gas could, however, without injury, be subjected to an enormous amount of washing, in (say) rotary washers—the only appreciable loss being of the easily soluble impurity; and lime would only be needed for the removal of the final traces. The water could be used for condensing, in the process of which the carbonic acid would be expelled; and after cooling it would be again available for further absorption. This would not be possible with carburetted water gas. It has been proposed to make water gas by injecting steam after all the gas has been evolved from the coal. The coke would, in fact, be partially cooled *in situ;* and when, after a few minutes, the temperature reached was too low to reduce the steam, it could be drawn in the usual way. The idea is probably more feasible than would at first sight appear.

As regards coal-gas production, it is satisfactory to note that considerable advances are being made in the economic handling of the raw material in the retort-house. The most ingenious machines of Messrs. Foulis and Arrol were fully described in a paper read before this Institution last year by Mr. Tysoe. Since then, their mechanical details have been greatly improved, not the least of which consists in the attachment of a very efficient motor. The wear and tear of the rams, too, was a serious item; and this has been completely overcome at the Vauxhall Gas-Works by wholly encasing them, and substituting cup leathers for the ordinary packings. So well has this answered, that, after being in use for a considerable time, the rams show no signs whatever of cutting. Altogether the machine promises well; and it is hoped that by next year some interesting comparisons will be possible under identical conditions of working. In the meantime, the advocates of inclined retorts have not been idle. The last remodelled retort-house at Brentford forms a subject of one of the papers which will be read in due course; and it need not be here referred to at great length. This much may at least be said—that a recent inspection demonstrated that it is possible, with the utmost ease, to charge a bench of 20-feet retorts fully and evenly, to burn off the coal thoroughly, but not excessively, in six hours, and to run out the spent charge with the utmost freedom. If satisfactory assurance can be given that wear and tear is not greater than with horizontals, and that variations in the quality of the coal can be readily dealt with, the problem of efficient and economic carbonization will be nearer solution than many imagined—at any rate, in small or medium-sized works. It should be a difficult matter, with any system, to surpass the figure of 1s. per ton given as the outside cost of carbonizing wages.

The enormous reduction in labour which these mechanical methods of stoking are bringing about, has been urged by some as an argument that the necessity for Sunday stoppage has disappeared. This view, however, is untenable, since, though fewer hands be employed, what holds good for twenty holds good for one. The late Labour Commission brought out the remarkable fact that Sunday cessation of gas making is by no means general, and this despite its able advocacy, several years back, by many of the leading gas engineers. With the introduction of gaseous firing, the only weighty objection to the plan falls to the ground; since the moment that ingress of air to the producer is stopped, the consumption of fuel ceases, and at the proper time can be re-started without the slightest difficulty, and with but little loss. To stop on Sunday, not a single valve has to be shut down excepting on the exhauster, in connection with which a small bye-pass governor should be used, having its bell weighted to give a pressure of from 1 to 2 inches on the condenser and hydraulic mains. This is the only, but imperative, precaution; and its absence has not unfrequently led to explosions in the foul and hydraulic mains during the stoppage of work. Its use makes these impossible. There is the further advantage, too, that the vacuum side of the exhauster is weekly put under pressure; and leakages therein, otherwise unnoticed, are easily localized and set right. A still further improvement would be to couple up the exhausters as closely as possible to the hydraulic mains, and put the whole of the condensing as well as the washing plant on its outlet. The reduced duty of the exhauster, due to gas temperature, would be counteracted by its filling under nearly atmospheric pressure instead of below it. The tarry vapours would be more easily condensable under pressure; and one of the most prolific causes of trouble with illuminating power and purifiers—the insidious drawing in of air—would almost wholly disappear. Air, or at least oxygen, is undoubtedly wanted later on; but let it be admitted where it is required, and in known and regular quantity.

An interesting discussion took place a few months ago between Dr. Hürter and Professor Lunge on the relative merits of coke and so-called "plate" towers. Gas engineers have, however, long since realized the disadvantages of coke for their own particular requirements; but probably few are aware that Mr. Green, of Preston, has had in use for several years an ideal material as regards surface, lightness, and absorptive power. This consists of canvas disposed within the scrubber in vertical layers—much after the same plan, in fact, as in the excellent method of using thin wood boarding, as introduced by Mr. George Livesey. So eminently adapted for the purpose did this material appear, that it has been used for making the so-called "bundles," of which the Kirkham washer-drums are built up, and with a large measure of success. The pattern exhibited will probably convey a better idea of its advantages than can be given by description; but it may be just pointed out that two or more widths of canvas are used in order to increase the amount of effective surface towards the periphery of the wheel, while not unduly restricting the gas area towards its centre.

It is regrettable that so little progress can be recorded, both as regards utilizing the capabilities of the "volatile alkali" existing in crude coal gas, and in its commercial manufacture by gas undertakings. When it is considered that something like three-fourths of the purification charges are entailed by the use of another alkali producing a troublesome waste, it is unfortunate that a larger measure of success has not attended the efforts of the many engineers and chemists who have essayed the task of better utilizing the affinity, unstable though it be, of ammonia for carbonic acid. Mr. Holgate's communication to this meeting will be all the more welcome, as proving that the gas engineers of the present day are not less alive to the importance of the subject than were their predecessors; and, despite past failures, it is not unreasonable to expect that ammonia will one day justify the hopes which have been founded upon it. Of not less importance is its profitable placing upon the market, which, at the present price of sulphate, can scarcely be considered the case.

Tar is now very generally sold under a sliding-scale, based upon the average price obtained for its chief products in certain agreed proportions. Ammoniacal liquor is also sold under a sliding-scale, which, however, is only determined by the price of sulphate. But should not liquid ammonia and carbonate be also taken into consideration; and would it not frequently be profitable if a portion, at any rate, of the available liquor were worked up into either or both of these products? A better price would be obtained upon the ammonia basis; and the withdrawal of a portion of the supply from sulphate making would enhance its value in this form. The economic disposal of sulphate is complicated by stocks and speculation—neither factor tending to the maintenance of a steady and regular trade. Low prices for sulphate render it all the more desirable that its manufacture should be run on the most economical lines possible. Continuous distillation, Mr. Wilton's salt-lifter, and Mr. Green's system of drying in bulk, are all useful aids in this direction.

But it has long been a matter of surprise that gas undertakings working up ammoniacal liquor into sulphate should not more commonly make their own acid. It is extremely satisfactory to find that the subject has not been overlooked, and that a paper is to be contributed to this meeting by Mr. Fletcher W. Stevenson, in which the advantage of such manufacture will be thoroughly discussed. When once acid making is established as part and parcel of the process of sulphate making by gas undertakings, greater care will be taken to utilize the sulphur contained in unpurified gas to a much larger extent than is now the case. If lime solely be used for purification, the whole of the sulphur becomes waste, and has to be disposed of as such in conjunction with the spent lime. Not only so, but a percentage of the lime has been diverted from its proper function of absorbing carbonic acid in proportion to this sulphur. Air accidentally drawn in between the exhauster and the retorts brings about this oxidation of the lime sulphide; and serious excesses of sulphur compounds in the finished gas have arisen from this cause. For since the lime is no longer existing as sulphide, the carbonic acid is unable to combine therewith, with evolution of sulphuretted hydrogen; and it therefore passes forward to the sulphide trays—rendering them also inefficient for carbon bisulphide removal. The remedy is either to interpose oxide of iron vessels, or, as suggested earlier in this address, to reduce to a minimum the possibilities of drawing any air. When, however, the carbonic acid and the carbon bisulphide have been removed, the remaining sulphuretted hydrogen should be profitably precipitated, and in large quantity, in the final purifiers. For this purpose, air or pure oxygen should be admitted to them, in quantity which, with air, will depend upon the amount of nitrogen permissible in the finished gas, and the back-pressure thrown by the trays of material as these become saturated. To overcome the latter difficulty,

Mr. F. S. Cripps has designed a special form of valve fixed in conjunction with each layer, and operated from outside the vessel. By this means, any tier can be bye-passed as it is fouled, and free access given to the superposed one. A very valuable adjunct in the catch-boxes is Weldon Mud, the use of which appears to be steadily increasing. With this material, an absolutely clean test is maintained on the outlet gas—a condition extremely difficult of attainment with oxide of iron; while the avidity with which it attacks sulphuretted hydrogen is such that this impurity may be freely passed to the very last layer of the mud.

The extending use of air in purification, resulting as it does in increased temperature in the purifiers and the finished gas, renders it all the more necessary that this should be carefully corrected to a pre-determined temperature; otherwise curious vagaries of "leakage"—or, more properly speaking, unaccounted-for gas—will result. Another error in station-meter registration generally overlooked and unprovided for exists when naphthalene deposits occur within the spout. The water-overflow box is placed in equilibrium by connecting it with a pipe to the meter-inlet; but should any loss of pressure occur between this point and the termination of the spout, the overflow-level will be unduly raised, and the meter-register fast. The proper remedy is to carry an equilibrium-pipe from the interior of the drum direct to the overflow-box, which then, under all circumstances, faithfully reproduces the water-level within the drum.

Though it would be a bold thing to affirm that finality in the general design of gasholders has now been reached, it may be considered as fairly certain that its modern form, as initiated by Mr. George Livesey, will not in the future be largely departed from. Holders of large capacity, and having their upper lifts extending outwards from the framing, have now been at work sufficiently long to justify the soundness of the change. The advantages of thus extending their size without unduly increasing the height of the superstructure, were cogently stated by Mr. Frank Livesey in his paper describing the largest example yet erected, read before this Institution in 1893. The only plausible objection raised against this system has been the expression of doubt as to whether, for the natural life of the holder, the sheeting of the outer lift would continue to stand the increased tensional strains due to wind pressure. Gas storage is, however, not provided to be always occupied to its fullest extent, but to compensate for irregularities in consumption and production. During last year, one of these holders at Kennington was inflated beyond the framing for 94 days; and economically to provide for this requirement—essential, too, during only a few winter months—is a very important gain afforded by the system. During the late severe frost, little more difficulty was experienced with holders thus constructed than with other portions of the plant; and it would be interesting to know whether the use of spiral-guided ones, ingenious though they undoubtedly are, has been unattended with more serious disadvantages.

Though gasholders provide a convenient equalizer of fluctuations in production or consumption, they can scarcely be considered to act as efficiently with regard to variations in illuminating power, the occurrence of which it is impossible to prevent. It is common experience that, when this does happen, the outlet is quickly affected. It would probably be of service to provide the inlet-pipe with a long hood—one end extending to the bottom of the tank, and the other containing one or more nozzles, by which the incoming gas would be delivered at the level of the crown, and would set in rapid motion the otherwise stagnant contents. An interesting portion of the bottom curb of an historic gasholder at Kennington (figured in "King's Treatise on Coal Gas"), which is now being removed, is exhibited.

Within the last three or four years, gas has added to its many other advantages by becoming the poor man's friend; the introduction of coin-freed meters bringing this about to an extent at one time undreamt of. Like many new systems, its success depends upon its proper application; for it is a department of supply which must be worked, in order to pay, on very different lines from the ordinary gas-rental office routine. The reflection cannot but be a pleasant one that the innovation of coin meters (so many excellent examples of which are now constructed) has neither owed its "notion" to America nor its manufacture to Germany, but that once more our own country has justified the pre-eminence it has in the past attained in an industry so peculiarly its own as "gas." If that supremacy is to be maintained, it will only be by means of continued application and patient research, by ever widening and ever extending our purview of those always-changing conditions it is our business to meet. Let us then avail ourselves to the utmost of the opportunities this Institution affords—by the reading of papers, the visiting of works, but, above all, by the mutual intercourse of gas engineers—to promote, in every sense, the welfare of an industry which is, year by year, becoming more firmly established as one of the great necessities of the age.

Mr. W. Foulis (Glasgow) said he thought all present would agree with him that they had seldom listened to a more excellent presidential address than the one just delivered. It touched upon so many subjects, in connection with gas manufacture, in which they were interested, and dealt with them in a very excellent manner. He had great pleasure in moving a very hearty vote of thanks to the President for his valuable address.

Mr. R. Morton seconded the motion; and it was carried by acclamation.

The President briefly acknowledged the vote.

Reading of Papers.

The reading of papers was then commenced. They were taken in the following order:—

Wednesday.—(1) "Workmen's Funds for Sickness, Accident, Old Age, &c." By George Livesey. (2) "The Work of the Photometric Standard Committee." By Vivian B. Lewes, F.I.C., F.C.S. (3) "The Modern Gas-Engine: Its Development and Applications." By G. Ernest Stevenson. (4) "The Temperatures Employed in the Distillation of Coal." By Lewis T. Wright.

Thursday.—(5) "Acetylene and Its Enrichment Value." By Vivian B. Lewes. (6) "The Monier System of Cement Construction as Applied to Gas-Works." By F. D. Marshall. (7) "Installation of Carburetted Water Gas at Tottenham." By A. E. Broadberry. (8) "Sloping Retorts." By J. Husband. (9) "The Manufacture of Sulphuric Acid by Sulphate of Ammonia Makers." By Fletcher W. Stevenson. (10) "Purified Ammoniacal Liquor, and Its Use in Gas Purification." By T. Holgate.

The first four of these papers, with a report of the discussion on Mr. Livesey's, are given in another part of the Journal; the remainder, with the discussions thereon, being held over for subsequent issues.

At the close of the discussions on Thursday afternoon, the general business was resumed.

The Autumn Meeting.

The President said the first point he wished to bring before the members was with reference to holding an autumn meeting. Mr. William King, of Liverpool, would be willing to receive them, and show his installation of water-gas plant; and there were a good many objects of engineering interest which they might take an opportunity of inspecting at the same time. He should like to have an expression of opinion from the members as to whether the Council should continue the practice of holding an autumn meeting; and he would therefore ask those in favour of it to hold up their hands.

A large number voted in favour of the meeting being held, and none against it.

The President accordingly announced that the meeting would be held, as usual.

Appointment of Scrutineers.

Messrs. Lacey, M'Minn, and Tysoe were unanimously re-appointed Scrutineers for the ensuing year.

Votes of Thanks.

Mr. John Methven moved that the best thanks of the meeting be given to the authors of papers. As years rolled on, he said, they found plenty of contributions of first-rate quality; and this was a subject for congratulation. It was well known that the proportion of working members in the Institution was very large; and he hoped they would be as successful in years to come as they had been hitherto. There certainly was no falling off of papers at the present meeting, either in number or quality.

Mr. C. E. Botley (Hastings) seconded the motion. On

many points, there might be differences of opinion; and it was only by full and free discussion, such as took place at these meetings, that the truth would be arrived at.

The motion was carried unanimously.

Mr. J. W. HELPS (Croydon) moved that the best thanks of the meeting be given to Mr. Magnus Ohren, for his services as Honorary Auditor. He remarked that the resolution needed nothing to commend it. They all knew Mr. Ohren, and were glad to see him again among them looking so well.

Mr. J. L. CHAPMAN (Harrow) seconded the motion.

The PRESIDENT, in putting the resolution, said they were much indebted to Mr. Ohren for his services; and it was very pleasing to see he still took as keen an interest in the affairs of the Institution as he had done in the past.

The motion was carried by acclamation.

Mr. BOTLEY then moved a vote of thanks to the Council, for their services to the Institution during the past year. He said it had been remarked that they had had some excellent papers at the meeting; and this depended to a great extent on the work of the Council. He knew what difficulties there were in securing a good meeting; and he felt the Council were eminently deserving of their thanks.

Mr. G. E. STEVENSON, in seconding the motion, said they must all admire the discipline and order with which everything connected with the work of the Institution was carried on; nothing being left to chance.

The motion was carried unanimously.

Mr. FOULIS proposed a very hearty vote of thanks to the President. He said they had had from him a most admirable address, which they would all read with a good deal of pleasure and profit; and they had seen the business-like way in which he had conducted the meeting.

Mr. METHVEN said he had great pleasure in seconding the motion, for he knew how thoroughly the President deserved it, not only for his conduct in the chair, but also for the amount of time and attention he had devoted to the Institution from the commencement of its career. Having himself been on the Executive for a year or two, he knew something of the work of the Council; and he was quite certain that no one could have devoted more time and energy to it than Mr. Carpenter. He would congratulate him on having so well occupied the chair; and he only hoped that, like some of the Past-Masters, he would not consider his duties to the Institution completed after having passed the chair, but would still devote his energies to the benefit of the organization as he had done hitherto.

The vote having been accorded by acclamation,

The PRESIDENT said he was very sensible of the hearty manner in which the proposition had been received. His work had been entirely a labour of love. It was because he felt so keenly that they wanted an Institution of the character which this one had turned out to be, that he gave it so much of his time and attention. It was said quite early in its career that it would be judged by its fruits; and, treating the papers they had been listening to as its fruits, he thought the verdict must be in every sense a favourable one. He then moved a vote of thanks to Mr. Cole, remarking that they could not wish for a more painstaking or industrious Secretary, or one who more thoroughly threw heart and soul into the work.

Mr. MAGNUS OHREN seconded the motion, which was carried unanimously.

Mr. COLE, in thanking the members most sincerely for the compliment, assured them that he was very proud indeed of being Secretary to the Institution. Some time ago, it was his duty to interview several members of the Council of the Institution of Civil Engineers; and he was then very pleased indeed to find the esteem in which the Institution was held at head-quarters. As long as he continued to hold his present office, it would be his pleasure to fulfil the duties to the best of his ability.

The proceedings then terminated.

PAPERS AND DISCUSSIONS.

WORKMEN'S FUNDS FOR SICKNESS, ACCIDENT, OLD AGE, ETC.

By GEORGE LIVESEY.

This paper is due to a suggestion made in the JOURNAL OF GAS LIGHTING in March last, in an able and sympathetic article advocating old-age pensions.

Until the introduction of the exhauster in 1850 or thereabouts, power-driven machinery was unknown in gas-works; and after that for many years it was limited to the simple operation of pumping gas and liquids. Now, the leading thought with engineers is how to displace hand labour by machinery; the motive being not so much for economy, as to be independent of labour. Independent, however, we can never be; for, develop machinery as we may, the human instrument must still be our mainstay, and the problem is how to secure his intelligent co-operation and goodwill.

In the JOURNAL OF GAS LIGHTING for April 16 last, an unknown writer, over the *nom de plume* of "Sentinel," begins a powerful letter thus: "It must be universally admitted that the labour question in conjunction with kindred matters constitutes the most vital, complicated, and important topic of our time. Certainly it will have to be grappled with; and to every appearance that right speedily. The subject affects gas undertakings acutely; and it may, unless settled, become chronic. Every one converses about it; and yet of all questions seriously discussed in our meetings and periodicals, this one receives the least and most scant attention. We are doing practically nothing to bring it to a head or to a satisfactory issue."

It has been said that the way to deal with labour is to make use of it so far and so long as it answers the purpose, and then to cast it off. Employers are not so much to blame for this opinion, because it is the direct outcome of the policy of the Trade Unions. Humanity and the common sense of the employers prevent the general adoption of this hard and short-sighted system, of which the only possible justification would be the impossibility of something better; and, happily, better things are possible. When businesses were small, and master and men lived and worked together, and where fair and considerate treatment prevailed, mutual goodwill was the result. Now such friendly personal relations are impracticable, partly because in large businesses employers cannot know their men individually, and partly because they and their men, and the circumstances of both, have changed, and separation, with prejudice and mutual want of confidence, are the rule.

The old relations of master and servant are gone beyond recall. The object now must be to make the new relations of employers and employed better than the old. To say this cannot be done, is to admit that the industrial world is retrograding in its most important particular, for the men are more than their work. It is more important that men, in the highest and best sense, should be made, than any mechanical or industrial work they can accomplish. If, therefore, employers and employed are to be, and are to remain, at enmity, the new is undoubtedly worse than the old. But we need not despair. The prize is well worth winning; but like all good things, it can only be won by well-considered patient endeavour. The employer occupies a position in which he may exert great influence with his men; and he ought to be, as he may be, their natural leader. If he does not take this position, so-called "labour leaders" will do so, who would speedily lead his men, himself, and the nation to ruin. They have gone some distance on that road already; and to show what they would do, it is only necessary to quote the Collectivist resolution, carried by 219 to 61 votes, at the Trades Union Congress held at Norwich last year: "That, in the opinion of this congress, it is essential to the maintenance of British industries to nationalize the land and the whole of the means of production, distribution, and exchange; and that the Parliamentary Committee be instructed to promote and support legislation with the above object." To do them justice, one of the oldest and strongest Trade Unions in the country—the boiler-makers—led by their Secretary (Mr. Knight) have, in consequence of this resolution, formally withdrawn from the congress.

It will perhaps be said: "What has all this to do with workmen's funds?" It has been shown that industrial conditions have entirely changed; that employers and employed have got out of touch; that the tendency is to still greater separation; and that it is necessary to re-establish satisfactory relations. The question that remains is: How to do it? How can mutual confidence and goodwill be created? The men are suspicious, and the employers are doubtful as to the course to take, which necessarily tends to inaction. There is no one panacea; but this is certain, that justice, liberality, and sympathy

on the part of the employer will tell. It is he who must make the first move; and as a step in the right direction, workmen's funds for sickness, accident, old age, &c., are recommended. There is an impression that such funds are common; but there are many prosperous gas undertakings' accounts in which there is no item giving evidence that any such fund is in existence. If not, why not? Is it due to want of thought or want of will, or to difficulties, real or imaginary, that stand, or appear to stand, in the way.

The professed spokesmen of Trade Unions have stated in the House of Commons that they are opposed to all workmen's funds in which employers and employed are associated. Their argument is that such funds tend to attach workmen to their employers; consequently they are inimical to the Trade Unions. They contend that Trade Unions are so necessary and beneficial that any advantages or privileges that tend to weaken their hold upon workmen must be rejected. This was the real reason why they objected so strongly to the so-called contracting-out clauses introduced by the House of Lords in the Employers' Liability Bill of 1893; because, as they said, in undertakings, such for instance as the North-Western Railway, where accident and other funds exist, it is very difficult for Trade Unionism to obtain a footing. On the other hand, if the Trade Union officials are opposed to workmen's funds to which employers contribute, the men, if left to themselves, are ready to co-operate heartily with their employers in their establishment and working. The question arises, whether the initiative should be taken by the employer or by the workmen. If the latter, the employer loses a fine chance of showing his sympathy with, and of making an important step towards gaining the confidence of, his men; and the same in regard to management. If this is left entirely to the men, the fund will probably not be administered so satisfactorily; and the employer will lose the opportunity of associating with them in the promotion of a beneficent object.

To simply give a subscription and take no further interest, is merely charity, which is good so far as it goes, but more is wanted. Further, it is not right that the largest contributor should have no voice in the management. To subscribe and take his proper share in administration, will bring the employer into such sympathetic contact with his men as will not only conduce to the success of the fund, but will also have the great collateral advantage of tending to bind together employer and employed.

A strong argument, hitherto untouched, in favour of these funds, and their chief recommendation, is that they make provision for the men in their time of greatest distress, when overtaken by sickness, accident, or old age. It is much at such times for a man to feel that his employer is his friend.

It now remains to consider how workmen's funds should be started, their nature and extent, the rate of contribution and benefit, the amount of the employer's subscription, and the system of management.

The best, in fact the only right way to start a fund to which employer and employed contribute is to call a meeting of the men to explain and discuss the project; and thus to determine its nature and agree on its rules. If the number of men employed is small, invite them all; if large, let them select a certain proportion—one in five, or one in ten, or any other convenient number—to represent them. It is not necessary that there should be a large number of members. When the South Metropolitan Company's sick fund was founded in 1842 only 7000 tons of coal were used in the year. The regular men must, therefore, have been a mere handful. But the fund was successfully launched; and, with no material alteration, it has worked satisfactorily to this day. There is no doubt that, however small the number of members, a sick club can be worked without any difficulty; but whether the number be large or small, it should be an entirely separate fund—it must not be combined with superannuation, for which purpose another and perfectly distinct fund is necessary. A simple sick fund may well include in its membership, in addition to the regular men, those who come year after year to work in the winter, and it should provide relief for temporary incapacity caused either by sickness or accident.

Such a sick fund should not create a reserve. To do so would necessitate larger subscriptions than would be otherwise necessary; would destroy the simplicity of the accounts; and would give every member a vested interest in the accumulated surplus, of which he could claim his portion on leaving, or on being discharged. A much simpler and more satisfactory plan is to guarantee the fund—that is, for the employer to subscribe yearly or half-yearly such an amount as, added to the subscriptions of the members, will meet the claims as they arise. This is necessary to give confidence to the members; and that it is not at all a serious matter is proved by the half-century experience of the working of the South Metropolitan Company's sick fund, of which an account may be here given with advantage.

The whole of the regular men, and those winter men who return year by year, subscribe voluntarily 3d. per week, which for convenience is stopped from their wages; and the Company contribute half yearly just so much as is necessary to enable the fund to meet its claims. The amount so subscribed by the Company is always less than the total payments of the members. It is found that the weekly 3d. of the workmen has to be supplemented by about 2½d. from the Company. The latter, however, keep the accounts free of charge.

The benefits are as follows: In temporary incapacity, caused by sickness or accident, 12s. weekly on the doctor's certificate is paid for three months, and 6s. a week for another three months; £12 10s. is paid on the death of a member; and £7 10s. on the death of a member's wife. But to meet these death claims, a special levy is made when the death takes place, which provides about four-fifths of the amount; the rest coming from the fund. Medical attendance is provided, for which 1d. per week per member is paid by the fund. In addition to the ordinary sick benefit, a special allowance of 6s., making 18s., is paid in the case of all accidents that are not directly due to the carelessness of the injured workman himself. Further, the Company's contribution provides pensions during life or widowhood for widows of men who lose their lives by accident in their employment. 15s. a week (sometimes 20s. according to circumstances) is usually given for the first year or two; but these pensions are ultimately reduced to a minimum of 10s. per week. The total payments for last year (1894), which may be taken as a fair average, were as follows:—

1. Sick pay				£2687	16 10
2. Death of members	£260	8	8		
3. Do. of members' wives	153	15	0		
				414	3 8
4. Doctors' fees				544	4 0
5. Accident pay (total)	£377	6	10		
6. Do, 11 widows' pensions	294	7	0		
				671	13 10
				£4317	18 4

The 3d. weekly subscriptions of about 4000 members (including winter men when at work) and the death levies produced	£2488	12	3	£4317	18 4
Company's contribution	1829	6	1		

The total contribution by the Company amounts to 0·06d., say $\frac{1}{16}$d. per 1000 cubic feet of gas sold. Of this, the charge for all accidents and the pensions to windows is only 0·024d., say $\frac{1}{40}$d. per 1000 cubic feet, or about $\frac{3}{4}$d. per member per week.

These figures prove at what small cost of trouble and money-responsibility provision can be made for temporary disablement by sickness and for all accidents; but they do not touch the larger questions of permanent relief and old-age pensions, for which a separate fund is necessary.

The subject of old-age pensions is one of the burning questions of the day. Germany has recently instituted a compulsory national system; while in this country a Royal Commission has just reported that nothing effective can be done by the State.

In the case of the salaried classes, the Government and many public bodies, joint-stock companies, and even private firms, make provision for superannuation by means of joint funds; and the system is very rapidly extending. It is, in fact, becoming recognized as right and necessary, on the ground that an employer does not feel justified in dismissing an old servant when he becomes infirm, while he also feels that it is not fair to expect him to give a pension towards which the recipient has contributed nothing. The usual plan is for the salaried official to contribute a certain percentage, usually 2½ per cent., of his stipend, to which the employer adds a like amount. Retirement takes place at 65 years of age; and the pension amounts to, but never exceeds, two-thirds of the then annual salary if the length of service extends to 40 years or more, and one-fortieth less for each year short of that period.

The fact that in the case of clerks and salaried officials, the system of old-age pensions is accepted as correct, and remembering that their salaries are usually paid during temporary absence from sickness, is a good reason for making a similar provision for wage-earners. It is true that they cannot be considered so permanently fixed in their employment as salaried officers. But this is a disadvantage that both employers and employed would find it to their interest to remedy; and the establishment of old-age pension funds would help very materially in that direction. That working men desire such provision is proved by the great Friendly Societies they have created for that purpose; and there is no doubt of their hearty co-operation with their employers in the formation and working of a superannuation fund.

To show how this may be done, it will perhaps be best to take as an example one that has been in operation since 1855. In that year, following the course he adopted with the sick fund thirteen years earlier, the Secretary and Manager obtained the assent of the Directors, called a meeting of the men, laid the plan before them, a resolution of approval was passed, a Committee was formed, rules were framed, and the fund was started with about 150 members. A much smaller number, however, could found and work such a fund. The subscription was fixed at 3d. per week per member, with the option of increasing it to 6d. The Company began by giving £50, and contributing £50 a year. This rose in the course of time to £100, £150, and £200; and now, to be on the safe side, it stands at a constant subscription of 3d. per member per week—the same as the members themselves—though the Company were advised in 1880, by Mr. Mark Knowles, that a contribution equal to 40 per cent. of the members' payments would keep the fund solvent; and for ten years, up to 1891, this was the rate of contribution.

The pension was originally fixed for all 3d.-a-week members uniformly at 10s. a week, and 15s. for 6d. members, to which after subscribing for ten years they became entitled at 65 years of age, if not able to work, except in special cases when 55 years was the limit. Now the amount of pension is governed by the number of years a member has subscribed to the fund, ranging from the minimum of 10s. to 16s. a week; and 65 is fixed as the age at which a man, whether he is worn out or not, can claim his pension. On the other hand, the Company can compel him to retire at that age, though, by mutual assent, he may continue longer at work. One advantage from the Company's point of view is that many old men who could not well be discharged, and who would otherwise be continued in their employment at wages which they could not earn, can now be dismissed with their pension with a clear conscience.

To meet the difficulty of members being discharged or leaving, two-thirds of their subscriptions, but not exceeding £5, is returned on leaving; and on the death of a member before he receives a pension, the whole amount he has paid, with interest, is returned to his widow. This is too much, and will shortly be reduced. There are rather more than 2000 members.

Members' subscriptions last year	£1675	15	5
Company's contribution of 3d. per week per member	1358	8	8
Interest on investments	973	7	1
Total	£4007	11	2

The payments were as follows:—

To 77 pensioners	£1977	9	4
To members leaving	293	5	9
To widows of members	111	6	5
Total	£2382	1	6

Leaving a balance of £1625 9s. 8d. for investment.

The Company's contribution amounts to 0·047d., or less than $\frac{1}{20}$th of a penny per 1000 cubic feet sold. The total payments by the members in the 40 years amount to—

	£17,654	17	3
The Company's contributions to	11,792	8	1
Interest on the investments	10,461	18	10
Profit on sale of investments	3,691	6	11
Total	£43,600	11	1

The total paid in pensions amounts to	£18,069	8	8
Amount returned on leaving or at death	4,413	19	10
Amount invested in the Company's "C" stock, paying about 5 per cent. on the investment	19,251	7	3
Balance awaiting investment and in hand	1,865	15	4
Total	£43,600	11	1

It is possible the Company's contribution may have to be somewhat increased for a time, because a large number of the members are old servants of the late Phœnix and the Surrey Companies, who only became subscribers to the fund on the amalgamation in 1880, and who have been and are being pensioned after a short term of membership. These exceptional circumstances may require exceptional treatment; but apart from them, the 40 years' experience conclusively prove that, at a charge of less than $\frac{1}{20}$th part of a penny per 1000 cubic feet of gas sold, added to a subscription of 3d. per week by each member, a liberal old-age pension fund can be provided.

The management of both the sick and the superannuation funds was vested absolutely in the Company; the only part the members take is as visitors for the sick club, which duty they perform very satisfactorily.

It cannot be denied that this system has worked well; but were the funds to be started afresh, the management would certainly take the mutual or co-operative form. This would now be more satisfactory for both parties; and it is gradually being adopted. To give the members the responsibility of a share in management is not only right, but it increases their interest in the fund, and at the same time it educates them in business affairs. The employer is relieved to some extent of responsibility by sharing the management with the members; and he is brought into friendly contact and conference with them to their mutual advantage.

The workmen themselves, some 25 or 30 years ago, established and have successfully carried on, a widows and orphans fund, which gives 2s. 6d. per week to widows, and 6d. per week for each child under 14 years of age. The members contribute 2d. per week; some of the officials subscribe; and the Company give annually a sum equal to the total contributions of the members. With an income of some £300 a year, much good work is done; and there is usually a balance for investment at the end of each year.

A few words in conclusion. That these funds are beneficial not merely in relieving distress, but also in creating sympathy between man and man, mutual confidence and good will between employer and employed, there is not a shadow of doubt. They can be worked at comparatively small cost, with little responsibility, and without any difficulty. It is very doubtful whether any money is more advantageously spent than that given to these funds. The total cost to the South Metropolitan Company is about 20s. per man per annum for sick, accident, and old age pay. Altogether it slightly exceeds $\frac{1}{10}$ of a penny per 1000 cubic feet sold. Even from this some deduction should be made, for most gas undertakings in the absence of such funds do something in an irregular way by continuing men in their employment when their working power is past.

There can, therefore, be no question as to the advisability of establishing these funds. There is, moreover, another good reason.

I remarked the other day that "the labour question is not yet settled;" to which was replied, "No; nor ever will be. Strikes, like wars, are stern necessities." But that is no reason why nothing in the direction of peace and good will should be done or attempted. To do nothing is the best—or the worst—as it is the inevitable, way to court defeat. These are not days in which we can stand still. The world will move; and if efforts are not made to bring capital and labour into accord, they must drift farther apart. Gas undertakings, from their peculiar circumstances, and being always sure of making profits, are in an exceptionally favourable position for working in this direction. They can do much, if not to settle, at least to materially improve, the relations of capital and labour. Starting with mutual funds, confidence will be created, and better things—even partnership, or, as it is now called, co-partnership—may be the outcome. For this, the foundation is thrift and confidence. If workmen can thus become part "owners of the means and implements of production" by which they live, and, of course, part managers also—an idea that is neither defeated, nor yet dead and buried—the ruinous collectivism of the Socialist Trade Union Congress will have its flank turned; and the nation, with its industrial forces united, will be saved from the fate of a house divided against itself. Why should not the gas industry take the lead in this great and necessary and beneficent work?

Discussion.

The PRESIDENT said he was sure they would all agree with him that their hearty thanks were due to Mr. Livesey for his able paper, and would join in expressing the hope that he would in future give them many more similar contributions on such important subjects. The sick, like the poor, they had always with them; and it had been a matter of considerable surprise to him that workmen's funds, both sick and superannuation, were not more common in connection with gas undertakings than they were. As Mr. Livesey had pointed out, they were sure of their profits; and there really was no reason against, but a strong justification in favour of, their taking full and proper care of their old and sick and disabled workmen. The best thing they could do with the paper would be to give it the most thorough discussion possible.

Mr. CHARLES HUNT (Birmingham) said he joined with the President in expressing the additional obligation Mr. Livesey had conferred on them in introducing the paper. It was a question which demanded their most careful consideration. Perhaps he might best contribute to the discussion by stating that one of the first acts of the Birmingham Corporation, when they took over the gas undertakings, was to establish a superannuation fund for the officials and a sick fund for the employees. The latter had been in operation for nearly twenty years; and he was bound to say that its influence had been most beneficial. It was not established altogether on the lines stated by Mr. Livesey in his paper. The men had to contribute 6d. per week, and the benefits they received were limited to 10s. per week in the case of illness; but this was extended for six months. Then for six months longer, they were entitled to 5s. per week; and for six months after that, to 2s. 6d. per week. The Corporation guaranteed the benefit; and they had almost every year to contribute towards it. The management was on lines which, he thought, would approve themselves to Mr. Livesey. At each works, the members annually elected representatives; and the Board of Management was composed of those representatives, with three others added as representing the Gas Committee. The Board were vested absolutely with the management of the fund; and they had power to recommend to the Gas Committee from time to time alterations of rules or additions to benefits as they thought proper; and it was rarely, if ever, that the Committee had to veto the recommendations thus made. He might say further that the contributions by the members were compulsory. He did not gather from the paper that they were in the case of the South Metropolitan Gas Company.

Mr. LIVESEY said they were practically compulsory.

Mr. HUNT said he would not discuss that further, because it was rather a moot point as to whether or not the membership ought to be compulsory. He might mention that there was no workmen's pension fund in connection with it. Mr. Livesey seemed to think that the superannuation should be separate from the sick fund. He (Mr. Hunt) had been rather inclined, during the last few years, to an opposite opinion. They found that this sick fund was used to a certain extent as a superannuation fund—that was to say, a member got almost past work, and was placed on the sick fund, and ran through his benefit. He then had to remain six months before he could commence again; and occasionally it happened that he retired at the end of the time with another allowance. Therefore if a superannuation fund could be grafted on to the sick fund, the cost would not be very materially increased, while the certainty of benefit to the members would be greatly augmented. He noticed that, in the case of the fund of the South Metropolitan Company, a levy was made in the case of the death of a member. In connection with their sick fund at Birmingham, no such levy was made; the 6d. per week covering everything absolutely. Returning again to the question of superannuation, he might say that an offer was made a few years ago by the Corporation to establish a separate fund; but it was found, from the Actuary's report, that the contribution required from the members would be somewhat large, while the benefit accruing from it would be very small—not more than 5s. a week. It always occurred to him that 5s. a week was an extremely small sum for a man to look forward to in his old age, and that no pension fund based on so small an allowance in old age had the slightest chance of success. He should himself place 10s. as the minimum to begin with; and even then it would be found that men would prefer to continue at work than take this amount. They had men continuing at work to an extreme age, whom they would prefer to place upon a superannuation fund. They did not feel justified in discharging them, so long as there was work they could fairly perform. Personally he was very much indebted to Mr. Livesey for having brought the matter forward.

Mr. W. FOULIS (Glasgow) said that, when the Glasgow Corporation acquired the gas undertaking, there was a sum in their hands—he forgot how it came there, but he thought it was an unexpected windfall. They agreed to put it aside, and from the interest upon it to pay pensions to old servants; and this had been done. In addition to that, there was at each works a sick fund, which was entirely managed by the men themselves. They received every encouragement; but the Corporation did not contribute in any way to the fund, as it was doubtful if they had any legal power to do so. The winter men leaving in March obtained whatever surplus there was. Hitherto these funds had done a great deal of good. Beyond this, special cases were, of course, always considered, and relief given in some way or another. They were all indebted to Mr. Livesey for bringing the matter so ably before them; and he (Mr. Foulis) was sure it would make him, and probably many others, think more on what could further be done in the same direction.

Mr. G. E. STEVENSON (Manchester) heartily endorsed what Mr. Hunt had said. to the effect that, if a superannuation fund existed, it would enable them to part with many old stagers among the workmen—worthy men whom they could not treat harshly, and who were kept on instead of being discharged. He thought that, if there were such a fund, it would be a benefit to the undertaking that such men should leave, because to continue to employ a large percentage of old men did not contribute to the economical working of the concern.

Mr. J. STELFOX (Belfast) said that, about ten years ago, he induced their Town Clerk to insert a clause in a Bill, enabling them to adopt some such scheme as Mr. Livesey had laid before them; but the pen was ruthlessly put through the clause in the House of Commons. He would not mention the member's name who was responsible for it; but he might say that he was certainly not a Conservative. They had had a benefit society for some years in Belfast; but it was simply formed by a few men. In his paper, Mr. Livesey said it was voluntary at the South Metropolitan works; but, for the sake of convenience, the subscriptions were collected in the office. In his (Mr. Stelfox's) opinion, it should not be a voluntary thing, because the men who would stand out, were the very men who would likely be the first to "send round the hat" when sickness came.

Mr. HUNT remarked that both the funds initiated by the Birmingham Corporation were legalized by their Act of 1883; and the compulsory portion of it was adopted by the men themselves.

Mr. ALFRED COLSON (Leicester) said he should like to thank Mr. Livesey for his excellent paper, and to express his thorough sympathy with the position he had taken up. The old relations between master and servant were to a very large extent a thing of the past, owing chiefly to the magnitude of the businesses they now had to control, and the difficulties in the way of the employers getting into close contact with the workmen. At Leicester, they had done their utmost to endeavour to get over these difficulties. They had established a number of institutions, in all of which both he and the Gas Committee took great interest. The result of these institutions had been that Trade Unionism had found it absolutely impossible to get any footing amongst them. There had been established, in the days of the old Leicester Gas Company, a sick society which was under the absolute control of the men themselves. He followed it very closely when he went to Leicester, and found it was on a downward course. The balance was becoming reduced year by year; and it ultimately ended in insolvency. The men asked him to take the matter up, and see what could be done towards bringing about a better state of affairs. The first thing he did was to call a meeting of the men to ascertain their views. He learned that they were very desirous that the officials should take part in the management—or, at all events, that the Engineer should have a large share in the control. After a good deal of discussion and investigation, a special set of rules were drawn up, under which every

department of the undertaking was to be represented in the management. The result of their work in connection with this fund had been that they had now got it firmly established upon a thoroughly sound basis, with a balance of something like £500 to the good. The subscription was 4d. per week, with a levy of 3d. on the death of either a member or a member's wife. The benefits were 10s. per week for seventeen weeks, 8s. for the next eight weeks, with 6s. for a further eight weeks, after which 4s. per week was paid for the remainder of an illness. Upon the death of a member, £8 were paid; and in the case of a member's wife, £4. Membership was practically compulsory; the subscriptions being deducted from the wages week by week, with the consent of the members. Without troubling them with further details, he might say that the whole thing had worked in a very satisfactory manner, and had been the means of establishing the most cordial relations between the men, the Gas Committee, and the officials. In addition to the payments by the men, the Committee had contributed annually the sum of £25. Without this contribution, the payments of the men would not quite meet the expenses. He was sure there was a field here which, if properly worked, would be the means of doing a very large amount of good in connection with the labour question—in fact, he believed it would do more towards the prevention of strikes than perhaps anything else.

Mr. W. W. Fiddes (Bristol) said that they had tried to carry out in Bristol something on very similar lines to those put forward by Mr. Livesey; but he was sorry to say that, owing to the labour trouble some few years ago, the whole thing fell through. Each of the stations had since taken up the matter; and they all went on different lines. He was afraid it would have to be dealt with in some way or another, or it would fall to the ground.

Mr. C. E. Botley (Hastings) remarked that all the benefits which were claimed by Mr. Livesey had been accomplished at Hastings, but in a different manner. In the first place, there had been in existence for thirty years a burial fund, which had always been eminently successful. The subscription was 2d. per week; and the payments were £10 on the death of a member, £6 10s. on the death of a member's wife, and from £1 10s. to £4 10s. on the death of a child. The fund was managed by the workmen, with the assistance of the Engineer, who was elected by them; and they had now money invested. As showing that the gas industry was not an unhealthy one, he might mention that last year, out of an average membership of 160, there were only three deaths—two old men, and one child who accidentally fell into the water. None of the wives or anyone else died. They had also started a superannuation fund, to which the men contributed 4d. a week; and they were entitled, if they met with an accident which permanently disabled them, to retire at once on 12s. a week. They could also retire at the age of 55 on a similar allowance; but they need not necessarily do so, unless they considered they were past work. This superannuation fund was started by him to meet the difficulty of discharging old men who had rendered the Company good service, and who were not provided for in any other way. The Directors contributed in about the same proportion as stated by Mr. Livesey—the Company paying nearly as much as the men. In case of sickness, on production of a medical certificate, a workman was allowed 10s. 6d. a week for four weeks; and in case of accident, they gave him full pay until he was well. Other sickness was provided for by other societies. These efforts to look after the men's interests had had a very marked beneficial effect in the relations between employers and employees.

Mr. R. O. Paterson (Cheltenham) said that, when he first saw the programme of the meeting, he was inclined to think the present subject was hardly a fit one to be brought before that assembly; but he confessed he had changed his opinion after hearing the paper and the discussion. It was an eminently suitable subject for a gathering of a body of gentlemen deeply interested, as they were, in the labour question. In regard to a sick fund, he might say that at Cheltenham they had had a sick and burial fund in operation for very many years—he believed it was instituted between 1854 and 1858. The money in hand at the end of the year was divided among the members who had contributed. The payments were much the same as those which had been previously mentioned; but, of course, in the case of epidemic sickness, the Directors had had to give considerable support. Having stated that, however, and his Directors having all along entertained for their workmen a deep sympathy, and dealt with them in a way that few employers would have done, he was not in the happy position of being able to say that their action had ensured them against the bugbear of Trade Unionism. Unfortunately, they had suffered very much from it during the last year or two. He must say that the cordial feelings which existed between the men and the Company did not exist to the same extent as formerly. He agreed most heartily with Mr. Livesey; and he felt that, if they could make a good workable scheme, it would do more than anything else to bring back the happy days when better relations prevailed between the employers and employed.

Mr. F. D. Marshall (Copenhagen) remarked, with reference to the question of compulsion, that he was in the position of being able to say that on the Continent there was no discussion of the question as to whether or not the workmen would consent to contribute to the fund. A gentleman with a cocked hat and a sword came and demanded the weekly payments; and if there was any doubt about the men, they would be simply told to leave. Of course, this method of procedure had its advantages; but there were also serious disadvantages. The ponderous machinery put in motion by the German Government to exact the payments, cost four times as much as would have to be paid in England for the collection. The weekly contributions required were rather small, both for the companies and the men; but, owing to the Government stepping in, the subscriptions were very largely increased. They had, however, merely to submit; there was no opportunity whatever for discussion.

Mr. Livesey, in reply, said that the discussion had been extremely satisfactory, showing as it did what he had known for a long time, that there was, and had been for many years past, a manifest and earnest consideration for the real welfare of their men. No better proof could be given than the instance stated by Mr. Stevenson, of old men being kept on at work after they were unfit, out of a feeling of kindness. Directors of companies and members of gas committees must, of course, be cognizant of the fact; and it was evidence that they were animated by feelings of humanity. But it would be much better to show their consideration and sympathy with their old servants on a definite plan by establishing a superannuation fund. He had been pleased to hear Mr. Hunt's statement that the Birmingham Corporation guaranteed the sick fund. If this were not the case, they must accumulate what they could in good years, so as to meet possible deficiencies in bad ones. With regard to the question of compulsion, he agreed with Mr. Hunt that it was desirable; but it was not legal. He might mention that, a year or two ago, there was a decision in the Law Courts raising the question whether these deductions were not a violation of the Truck Acts. He brought the matter before a representative gathering of their men; and they begged him not to raise the question. The men were most anxious that the decision should not affect their funds; and no change was made in the system in vogue, of deducting the weekly subscriptions from wages. He had since ascertained that it was perfectly legal to deduct these contributions from wages week by week, provided the men agreed to it. This he had had from the Home Secretary himself. As to the superannuation fund being separate from the sick fund, it was simply a matter of opinion. His experience was that it was better to keep them separate. It was true the great Friendly Societies had sick and old-age benefits combined. The reason he thought it better to keep them separate was that the sick fund should not accumulate any balance whatever—it was much better to keep it simply going year by year; and then there could be no question, on men leaving, of them having a right to any repayment. This point was raised before the Labour Commission. The Registrar of Friendly Societies said: "If a man is discharged who has subscribed to a sick fund, he is entitled to a return of his share of the accumulated balance in hand." He was then asked: "Suppose there is no balance, and that the fund simply paid its way from year to year only?" Then, he admitted, when the man left, he had no right to any return; and he was no loser. The subscription covered the right to benefit during the term of his employment; and no more. A superannuation fund necessitated large accumulations; and he was not surprised to hear from Mr. Hunt that they were stopped

by the Actuaries' report. As to the legality of corporations contributing to these funds, he was very doubtful whether the objection was sound; but it would be presumptuous for him to put his opinion against that of legal gentlemen. The best way was not to ask them about it, but to do it. Many years ago, when the Board of Trade Auditor was first appointed for the London Gas Companies, he said: "The Gas Company is in the position of a large employer of labour; and whatever is right and proper for a large employer to subscribe to, the Company may subscribe to, if it is for the benefit of their own men;" and he never objected to any expenditure of this kind. If they consulted an actuary about the superannuation fund, he would probably say the contributions which the men should be willing to subscribe would not be sufficient to pay any pension worth having. Their superannuation fund was established in 1855; and the 3d. a week contributed by the men, with an equal amount contributed by the Company, had been more than sufficient to keep it going—in fact, it was proved that if the Company contributed 40 per cent. of the members' contributions, it was sufficient; but taking into account the old servants of the late Phœnix and Surrey Companies, the Company's contribution had lately been increased to an amount equal to that of the members, in order to be on the safe side. They had accumulated £20,000. They had invested the money in their own stock, on which they obtained 5 per cent. The total cost of the superannuation fund was $\frac{1}{20}$th of a penny per 1000 cubic feet of gas sold, added to the subscriptions of the members. He very much sympathized with Mr. Paterson; but Mr. Colson had told them that he had, by these means, succeeded in preventing the advent of the Union altogether. The South Metropolitan strike was really against the principle of workmen's funds. The Union said if they allowed the profit-sharing system to be established, the workmen would become attached to their employers, and they (the Union) would have no chance. Therefore they tried to nip it in the bud. He was rather amused with what Mr. Marshall had told them; and he thought this German experience of compulsion was not at all satisfactory. At all events, the system was vastly more expensive; and it went to prove the advantage of the English system of voluntary action. If directors and gas committees would take up this matter—as many of them were doing—by voluntary action, they would be able, at small cost, to solve for their men one of the greatest problems of the day.

THE WORK OF THE PHOTOMETRIC STANDARD COMMITTEE.

By Vivian B. Lewes, F.I.C., F.C.S.

The Photometric Standard Committee, having, after an immense amount of careful work, brought their somewhat protracted labours to a close, a short discussion of the conclusions which have been arrived at, and the recommendations which the Committee have submitted to the Board of Trade, will have more than usual interest, not only for the gas engineers of London, but for all connected with the gas industry.

Without going into the *minutiæ* of the work which has been done, an account of which is to be found in the appendix to the report, it will be sufficient to bring before you the causes which led to the appointment of the Committee, the suggestions made to them by deputations representing the Incorporated Institution of Gas Engineers and the Incorporated Gas Institute, and to indicate how far the recommendations of the Committee carry out the desires expressed by those best fitted to judge as to what was wanted to place photometric methods on a more satisfactory footing.

The reports of the Board of Trade Committee in 1881, the Gas Institute Committee in 1884, Mr. Dibdin's report to the Metropolitan Board of Works in 1885, and the report of the British Association Committee in 1888, all agree that the sperm candle is not a reliable standard of light; and in 1888 the London Gas Companies felt that the question was one of such importance to their interest, that a deputation, consisting of the Engineers to these Companies, waited upon the Gas Referees, with a view of arriving at some definite understanding as to the methods to be legalized for testing the illuminating value of the coal gas supplied to the Metropolis. The views expressed by the members of this deputation were so important, that it is as well to give them *in extenso*:—

April 18, 1888.

Gentlemen,—With reference to the interview which the undersigned had with you to-day on the part of their respective Companies, with a view to arriving at some definite understanding on the question of photometry as applied to the testing of the respective gases supplied by the three Companies, we beg respectfully to summarize what we have to say on this subject.

(1) We are of opinion that it is desirable to substitute for candles a more reliable standard, if it can be mutually agreed upon.

(2) The standard which we should propose would be of the same nature as gas, and which can be easily worked, and which would be equally affected by atmospheric conditions.

(3) The illuminating power of such standard should be (say) of 16, or not less than 10 candles; the object being that any want of clearness in the atmosphere of the photometer-room would correct itself in practical working by reason of the disc being about the same distance from both gas and standard.

(4) The way we should propose to determine the value of any new standards would be by a long series of experiments, conducted by a Commission in which the Municipal Authorities and Companies should be represented; the whole to be supervised by the Referees.

(5) We consider that the form of the photometer and the standard are so mixed up that it is desirable they should be considered together, and that they should be of such a character that every part can be reproduced, and the whole form an instrument that would be complete in itself, and capable of being stamped; and that all photometers should be alike.

(6) We are of opinion that, in determining the standard and photometer, care must be taken that the results given shall not vary from those given by the photometers in use at the time of the passing of the Act of 1876, when the 16-candle burner was defined.

(7) We are of opinion that legislation should not take place until all the parties interested have come to an agreement as to what is the best form of photometer and standard to be adopted.

We remain, Gentlemen, your obedient Servants,

(Signed) G. C. Trewby. Frank Livesey.
Robt. Harris. H. E. Jones.

This letter is of importance, as it clearly shows that the Gas Companies felt the gravity and urgency of the subject quite as strongly as the Board of Trade and the London County Council. This unanimity of opinion led to the suggestion that a representative Committee should be constituted to consider the whole question. But both the Board of Trade and the London County Council pleaded that they had no funds out of which to institute such an inquiry; and the whole matter would have had to be shelved had not the South Metropolitan Gas Company offered to bear the cost, provided that a thoroughly representative Committee could be induced to undertake the work. In consequence of this offer, the Committee was finally appointed in December, 1891, under the following minute of the Board of Trade:—

Dec. 23, 1891.

My Lords are pleased to appoint—

W. J. Dibdin, Esq.	William Odling, Esq., F.R.S.
E. Frankland, Esq., F.R.S.	George Rose-Innes, Esq.
H. E. Jones, Esq.	W. J. Russell, Esq., F.R.S.
George Livesey, Esq.	G. C. Trewby, Esq.

and the Gas Referees,

as a Committee to inquire into and report to them upon the subject of the standards to be used for testing the illuminating power of coal gas.

Initialed—H. G. C. (Signed) M. E. Hicks-Beach.

It will be at once seen that the wording of this minute unfortunately restricted the work of the Committee to an inquiry into the standards of light to be employed, and left out of the question the equally important point of photometers—an omission which observers most versed in the subject will regret, since uniformity in the type of photometer used is undoubtedly one of the most important factors in obtaining consistent and reliable results.

So much has been said and written as to the unfitness of the sperm candle as a standard of light, that it seemed almost unnecessary to re-open this part of the subject; but the Committee, being desirous of making their work as complete as possible, went fully into the process of manufacture employed, and the preparation of the materials used in making the candles for photometric purposes. They came to the conclusion that the variations in the amount of light emitted by candles were due to two distinct sets of causes—first, slight variations in the material and methods of manufacture; and, secondly, the conditions under which the candle was burned.

It may be taken as probable that, if an official manufacture of sperm candles were undertaken under good direction, and regardless of cost, many of the existing sources of variation might be removed. The spermaceti employed (of which, however, the supply is noticeably diminishing) might be subject to special preparation and determination of its melting-point; and the exact proportion of wax of a definite character, used in addition,

might be rigidly fixed. The wick might be made more uniform by a careful selection of the cotton, by keeping the twist of the thread constant in spinning, by fixing the number of threads in each strand, by plaiting with a definite strain on each strand, by regulating the number of crossings per inch of plait, by prescribing the strength of the solutions of boracic acid and sal-ammoniac in which the wicks are steeped, the time of steeping and mode of drying, and by attending to the strain put on the wicks and the absence of twist when they are set in the moulds.

But when all this had been done, very little would have been gained. There would still remain the variation in the amount of light given by the individual candle, irrespective of its fellows, according to the mode of its burning, as affected by the curvature of the wick, the temperature and movements of the surrounding air, the length of time the burning had been going on, the fulness or dryness of the cup, and the varying treatment of the candle by the particular gas examiner. It is easy enough to point to the faults of the candle after its thirty-five years of service; but the *crux* of the question arises when attempts are made to find a more reliable, and at the same time equally convenient, standard to take its place.

It is manifest that, in order to avoid utter confusion, the light emitted by the coal gas, when burned under the specified conditions, must still be expressed in terms of candle light; and though the specified standard to be used in actual testing may be of greater value than the light of one candle, yet it is absolutely necessary to have a reliable 1-candle unit from which to standardize any multiple candle standard that might be fixed upon.

The methods which have from time to time been suggested for the production of a light equal to that emitted by the flame of one standard candle are not numerous; and it is as well to glance at the most promising among them.

The amyl-acetate lamp, devised by Herr Hefner-Alteneck, is practically a spirit-lamp burning the vapour of amyl-acetate. The wick is contained in a round tube of German silver, 8 mm. in diameter and 25 mm. high. It is formed of a strand of cotton yarns, and is so regulated as to produce a flame 40 mm. in height. Under these conditions, it is supposed to give a light equal to one candle; but in some experiments made by Mr. Dibdin, it was found that the height must be increased to 51 mm. in order to give a light agreeing with one candle of the Methven standard. The great drawback to it is the red colour of the flame, which renders it very difficult to compare the light emitted by it with any source approaching white light. Perhaps the most scientific and least practical standard which has been proposed was that the unit of light should be that emitted by a square centimetre of platinum at the point of fusion, as suggested by Professor Violle; but the insurmountable difficulties attending its use would always prevent its adoption. The most convenient standard of light, and the one most used for practical testing in gas-works is the Methven screen, first introduced in 1878, which consists of an upright rectangular metallic plate fixed in front of a "London" Argand burner. An upright plate has an opening which is covered by a thin silver plate, having a vertical slot of such dimensions as to allow of the passage of as much light, when the Argand burner is provided with sufficient gas to give a flame 3 inches in height, as that afforded by two average standard sperm candles. It is manifest that, when used with coal gas, it is only within certain limits that a small portion cut out of the original flame could be relied upon to emit a practically constant light; and that, although these limits are well within the illuminating value of the London gas supply, it is still very advisable to obtain greater constancy in results, which is done by using an aperture of smaller area, and carburetting the coal gas in the burner with pentane.

Perhaps the most important of all the proposed standards was Mr. Vernon Harcourt's 1-candle pentane unit, first described by him at the meeting of the British Association for the Advancement of Science in 1877. The gas used for this standard is made by bringing together, in a gasholder, air and the highly volatile liquid pentane, in the proportion of 1 cubic foot of air and 3 cubic inches of pentane. The pentane to be used is a mixture of pentane with some of the paraffins of lower and higher boiling-points, and is prepared by distilling the light petroleum at 60° C., at 55° C., and twice at 50° C. The pentane thus prepared must satisfy the following tests: On agitation with 1-20th of its bulk of fuming sulphuric acid for five minutes, it must impart to the acid only a faint brown colour. Its liquid density must be between ·62 and ·63 at 62° Fahr. The liquid must evaporate, absolutely without residue, at the ordinary temperature, when the tension of its vapour is not less than 7·5 inches of mercury. The density of the vapour compared with air must not be less than 2·47, nor greater than 2·53.

The standard 1-candle pentane unit burner consists of a brass tube 4 inches in length and 1 inch in diameter, which the gas enters towards the bottom. The upper end of the tube is closed by a brass plug ½ inch in thickness, in the middle of which is a round hole ¼ inch in diameter. Around the burner is placed a glass cylinder 6 inches by 2 inches, the top of which is level with that of the burner; air entering through the gallery on which the chimney stands. Above the burner is supported, at a height of 63·5 mm., a piece of platinum wire about 0·6 mm. in diameter, and from 2 to 3 inches in length. The air gas passes through a small meter delivering at each revolution 1-60th of a cubic foot, and then through a small governor fitted to regulate the flow to 0·5 cubic foot an hour. The height of the flame is adjusted by means of a delicate stop-cock, until the top of the flame appears to touch, but not to pass, the horizontal platinum wire, which is adjusted so as to be exactly over the flame, and to extend not less than ½ inch beyond it.

Experiments with electrical standards having shown them to be untrustworthy, and as the impracticable nature of the Violle platinum standard renders its adoption impossible, it is evident that, for the present at least, the standard must be a flame; and the work done by previous Committees clearly points to Mr. Vernon Harcourt's 1-candle unit as being the most exact and easily reproduced. The report of the Board of Trade Committee in 1881, Mr. Dibdin's report to the Metropolitan Board of Works in 1887, and the report of the British Association Committee in 1888, were all in favour of its adoption.

In investigating the apparent discrepancies existing between the results of various observers as to the relative value of standard candles and the 1-candle pentane air-gas flame, it was felt that, unless it were possible to reproduce candles of exactly the same character as those used at the time of the passing of the Act of 1876, any such experiments would have no greater value than the numerous and careful investigations which have already been made.

On collecting all the available evidence from the work of previous observers, it was found that Mr. Harcourt and Mr. Harold B. Dixon, in 1878, found that the pentane unit gave an amount of light identical with the standard candles then made by Mr. Miller; and that again, in 1891 and in 1892, the latter observer, in a series of experiments extending over several months, found the pentane unit, used in the same way as in 1878-81, ascribed the same value to the candles of the same maker now as it did then.

In 1887-88 several long sets of experiments were made by other observers, equally skilful and as well qualified for the work, all of which experiments gave a higher value to the pentane unit than the one standard candle. On investigating the probable causes which might have brought about these discrepancies, it was found that Mr. Harcourt and Mr. Dixon have in all cases screened the eye from the luminous portion of the flame while setting it, so as only to see the cross wire and the extreme tip of the flame; whereas others have set the flame with the eye exposed to the whole of the light from the flame. In view of this, it was suggested that the variation found by different observers in the amount of light emitted by the 1-candle unit was probably due to its being sometimes set while the eyes were screened from the luminous portion of the flame, and sometimes, by other experimentalists, when the eyes were exposed to the whole flame.

In order to test how far this does affect the height of the flame, and the consequent quantity of light emitted, sets of observations were taken by two, and sometimes three, persons; the following method of making the experiment being adopted in each case.

A 10-candle pentane Argand was arranged at one end of the bar as a constant source of light; while the 1-candle unit, set alternately with and without the aid of the screen, was used to test its illuminating value. Each observer independently set the height of the flame without a screen,

so that the flame should come well in contact with, but in no case show above, the wire. Three readings were then taken, and the same observer then set the flame again; using a screen and slot so that only the wire and extreme tip of the flame were visible—the tip just touching the wire. Three readings were then again taken; and the second observer proceeded through the same routine. The mean of these experiments shows that a variation of 2·6 per cent. is introduced by the method of setting. In making the experiments, the height of the Harcourt unit flame was not corrected for barometric pressure, but was each time set to the 63·5 mm.

Other sets of experiments were then made; and the results may be summarized as follows:—

Series	I.—	66 observations,	mean difference	2·7
,,	II.—	102 ,,	,,	2·4
,,	III.—	108 ,,	,,	3·1
,,	IV.—	216 ,,	,,	2·4

Or 492 observations show a mean difference of 2·59 per cent. These results prove clearly that the discrepancies noticed were due to the methods employed in setting the flame; and as there is evidence to show that in the experiments conducted by Mr. Dibdin, by Mr. C. Greville Williams, and for the British Association Committee, the height of the pentane flame was fixed when the eye of the observer was not screened, the value of the pentane 1-candle flame, expressed in terms of standard candles, would be 2·6 per cent. too high. Making this correction, the results obtained by all experiments would be:—

Observer.	Value in Standard Candles.	Date.
Mr. Vernon Harcourt	0·994	1879
Mr. F. Livesey and Mr. Browne	0·990	1879
Mr. H. B. Dixon	0·998	1881
Mr. Dibdin	0·998	1887
Or including all experiments	1·016	1887
British Association Committee.	1·006	1888
Mr. Greville Williams (*a*)	1·008	1891
Mr. Greville Williams (*b*)	1·050	1891
Mr. H. B. Dixon	0·998	1891–2

The mean value of all experiments made between 1878 and 1892 with the pentane unit against standard candles, when so corrected, ascribes a value of 1·007 candles to the pentane flame when burning 63·5 mm., instead of the value 1·021 obtained from the uncorrected experiments; and if one abnormally high result be omitted, the value becomes 1·001 candles.

It was felt that, in order to reduce as far as possible any errors which atmospheric influences might introduce into the photometric observations, it would be best to adopt for the daily testing of gas a standard burner giving a light nearly approaching that of the flame to be tested, which can be easily worked, in which slight errors in manipulation shall not give rise to serious errors in the results, and which shall be less affected by external causes than the unit.

The 10-candle pentane Argand, as proposed by Mr. Dibdin, seemed to satisfy all the requisite conditions for a standard flame; and experiments were made to see how far it complied with these requirements under the ordinary conditions likely to occur in gas-testing, and to what extent variations in the method of using it might influence its illuminating value. Experiments showed that, even with extreme variations in the flame, such as could only be obtained with gross carelessness, the variation in the amount of light emitted was but small; and when such variations did take place, the light emitted by the standard was less than 10 candles, and therefore in favour of the gas.

A long series of experiments made by Mr. Dibdin shows that, when pentane is used, either air or coal gas gives the same result in the burner; and as long as the bottom of the carburettor is well covered by the pentane, the depth of the hydrocarbon makes no apparent difference.

The following table gives the summary of the 480 experiments made to determine these points; the comparison flame being a cut-off Argand emitting a constant light:—

Depth of Pentane in Carburettor.	Pentane Argand with Coal Gas.	Pentane Argand with Atmospheric Air.
0·250	13·85	13·86
0·750	13·89	13·88
1·125	13·88	13·87
1·500	13·88	13·87
1·750	13·90	13·90
2·000	13·89	13·90
2·250	13·89	13·89
2·400	13·77	13·85
2·500	Gas could not pass; carburettor full.	

A number of experiments were also made to see how the light of the flame was affected by the influence of temperature on the pentane in the carburettor; and it was found that, with a range of from 42° to 73° Fahr., the light emitted by the burner underwent no alteration.

In order to ascertain if the 10-candle pentane Argands could be made in quantity with such accuracy as should ensure their practical uniformity, Mr. William Sugg was requested to make two dozen of them, which were distributed among members of the Committee, who tested them, and found that they all gave results practically identical with one another; showing that no difficulty will be experienced in producing a number of these burners suited to serve as standards. As each burner will have to be measured and certified by the Board of Trade, and tested for illuminating value by the Gas Referees before being issued for testing purposes, it is manifest that no anxiety need be felt on this score.

A full description of the burner will be found in the appendix to the report; and a number of experiments were made in the hope that it might be possible to simplify the structure of the burner without affecting the constancy of the light emitted by the flame when at various heights, and without making the flame less steady. The perforated cone was removed, and a rectilinear cone without perforations was substituted; the perforated cone was used without the gallery which surrounds it; the small solid cone beneath the burner was removed, and altered in form and position. In nearly every case the original burner gave more satisfactory results than the modified form tried; and the conclusion was arrived at that the 10-candle pentane Argand would, with a slight modification, be in every respect a trustworthy standard when supplied with atmospheric air carrying the vapour of pentane. The modification alluded to is the substitution of a rectilinear for a curvilinear solid cone, and the definition of the distance at which it is to be fixed below the centre opening of the burner.

With the object of determining as accurately as possible the height at which the cut-off screen must be fixed in order that the light emitted by the unscreened portion of the flame shall be exactly equal to that given by ten standard candles, large numbers of experiments have from time to time been made. In July, 1893, a series of experiments were made by certain members of the Committee, among whom were the Gas Referees. Further independent observations have also been made by Mr. Dibdin, Mr. Harcourt, the Secretary, and the Gas Companies; and the mean of some thousands of observations gives 2·15 inches as the height above the steatite at which the screen must be fixed. As this is in accord with that arrived at in July, 1893, it has been adopted by the Committee.

Mr. John Methven found, as the result of a long series of experiments, that, when the temperature was practically constant, candles gave, per 120 grains of sperm consumed, a light equal to 1·104 as compared with a constant source of light (Methven screen), and that this was increased to 1·196 when the air in which the candles were burning was dried. This difference in the light-value he considered to be entirely due to the removal of moisture, as the temperature remained the same.

He also found that when air at increasing temperatures is supplied to a flame, saturated with moisture, the light-value is rapidly diminished; so that between the temperatures of 50° and 75° Fahr., a diminution of 10 per cent. takes place in the light emitted by an Argand flame burning 5 cubic feet of gas per hour, while with a flat flame a reduction of 12·2 per cent. took place, and with a gas-flame from a 2-candle burner a loss of 18 per cent. was found within the same range of temperature. The greater loss observed with the flat flame and the small jet, Mr. Methven ascribes to the different power of the flames to battle with the aqueous vapour. To dry the air used in these experiments, it was passed from a gasholder through a leaden chamber over the surface of sulphuric acid; while to saturate it, the sulphuric acid was replaced by water. At the end of the chamber was an upright tower, on top of which the flame burned, surrounded, in the case of the 2-candle burner, by a lamp chimney, and in the case of the flat flame by a glass globe.

In view of these interesting and important results, the Committee decided to make further investigations. A long series of experiments, extending over seven months, was made upon the effect of the humidity of the atmosphere upon the 1-candle pentane unit, the 10-candle pentane Argand, and the flame of the "London" Argand,

when consuming 5 cubic feet per hour of 16 to 17 candle gas; and the Committee came to the conclusion that though, by abnormally saturating or drying air supplied to a flame, variations as great as those obtained by Mr. Methven undoubtedly occur, yet that, in a well-ventilated testing-room, with the temperature kept within a narrow range, no such great differences are to be found.

The work of the Committee would manifestly have been incomplete had not special attention been paid to the subject of pentane and its production. The hydrocarbon known as pentane is the fifth member of the $C_n H_{2n+2}$ series; and it may be obtained by purifying light American petroleum by the successive action of sulphuric acid and sodic hydrate solution, and then fractionally distilling. Iso-pentane can also be obtained from fusel oil or crude amyl alcohol by purifying it by fractional distillation, converting it into amyl iodide, and then reducing this compound by means of a zinc-copper couple with liberation of the iso-pentane. Pure iso-pentane was prepared in this way from Irish, Scotch, and German fusel oil; and the experiments point to the conclusion that, while the 1-candle pentane burner is not adapted for the consumption of pentane air gas made indifferently from petroleum pentane or pure iso-pentane, the pentane Argand enables either of these combustible materials to be employed without any practical difference in the amount of light passing under the screen, and employed as a standard. Hence, should there be at any future time a suspicion that commercial pentane has altered in respect of its illuminating value, it can always be standardized by an appeal to the light of the pentane Argand burner fed with air-gas carburetted with pure iso-pentane.

Having given this light sketch of the work done by the Photometric Standard Committee, it will be well to see how far the recommendations made in their report to the Board of Trade (printed *in extenso* at the end of this paper, for reference) fulfil the desires expressed by the deputation promoted by this Institution.

The Committee were well advanced with the work when they were asked to receive a deputation representing the Incorporated Institution of Gas Engineers and the Gas Institute; and, at the meeting, the following resolutions were submitted to the Committee, and may therefore be taken as representing the general feeling of the gas industry:—

That the opinion be strongly impressed upon the Committee that no standard will be acceptable to the gas interest generally unless based upon, and of the same relative value as, the existing parliamentary standard candle or unit of light. The representatives of the Incorporated Gas Institute would also urge on the Committee the necessity that the present obligations of gas suppliers should not be in any way injuriously affected.

That attention be drawn to Mr. Methven's experiments showing the influence of the hygrometric condition of the atmosphere on the pentane unit of light; correction for this source of error appearing to be necessary to enable the pentane candle to be used for standardizing.

That air carburetted with pentane be used for testing purposes.

That a multiple of the standard candle, equal to 10 candles, be produced for testing purposes by the application of a screen to an Argand burner; and that all tests be performed with an open bar photometer not less than 60 inches in length.

That the rate of consumption of the gas to be tested be adjusted as nearly as practicable to the maximum efficiency of the various standard burners.

On now turning to the Committee's report, it will be seen that each of the five resolutions laid before the Committee has been met in a manner which must be thoroughly satisfactory to everyone who has the welfare of gas manufacture at heart.

The first resolution has been fully carried out by three years of constant experiment, during which period thousands of experiments have been made, and every precaution taken to clear up anomalous points, and to ensure the new unit having the same value as the old.

The influence of the hygrometric condition of the atmosphere upon the standard unit, upon the 10-candle pentane Argand, and upon the coal-gas flame in the "London" Argand, not only formed the subject of continuous experiments extending over seven months, but wet and dry bulb thermometers having been provided at the three City stations, daily comparisons at each station of the hygrometric condition of the air, and the illuminating power of the gas taken for over a year, amply confirm the conclusions arrived at by the Committee.

The third resolution is fully met by air carburetted with pentane being recommended for use both in the unit and multiple burner; while the adoption of the Dibdin 10-candle pentane Argand as the standard for use, meets the desire expressed in the first portion of the fourth resolution—the second portion, dealing with the photometer to be used, being unfortunately beyond the scope of the Committee's power.

The fifth resolution is perhaps the most important, in practice, of them all, and has been met in the most practical and satisfactory way by the thirteenth paragraph of the report, which recommends the legalizing of a method of gas-testing in which the gas shall be burned from the standard "London" Argand at whatever rate is found requisite in order that it may give a light equal to 16 candles, and in which the illuminative value of the gas shall be calculated from the volume of gas consumed.

The "London" Argand being specially constructed, and its air supply regulated, to develop the light from 16-candle gas consumed at a definite rate of flow, it is manifest that if the gas be below this illuminative quality, the 5 cubic feet will not need so much air for its consumption, and in consequence will be overburnt by the amount supplied by the burner—thus causing a serious falling off in the light developed. If, however, the flow of gas be increased until the 16 candles of illumination are produced, the air supply will be in proper ratio to the gas, and its illuminating power correctly indicated.

Gas managers must bear in mind that, as soon as the recommendations of the Committee have been legalized by Parliament, two serious risks of injustice to the quality of their gas will be removed. At present the want of uniformity in the standard used will often make a difference of more than half a candle in the value ascribed to their gas; and though they may smile upon its foibles when a 16·7-candle gas is recorded as 17·2-candle gas, they must always bear in mind that there is an equal chance of 15·8-candle being reduced to 15·3-candle, with the consequent inevitable proceedings, while should the gas be low in quality, burning it at the rate of 5 cubic feet an hour further increases the deficit.

It will only need a short acquaintance with the new 10-candle standard to impress those interested in gas testing with the fact that they owe a deep debt of gratitude, not only to the South Metropolitan Gas Company, whose action rendered the Committee a possibility, but also to the members of the Committee, who, having given their services, preferred to work out the problem submitted to them without heed of the time or trouble it entailed, rather than satisfy the hasty few who imagined that so important a question could be settled in a few months.

REPORT OF THE PHOTOMETRIC STANDARD COMMITTEE,

REFERRED TO IN THE FOREGOING PAPER.

To the Right Honourable the PRESIDENT OF THE BOARD OF TRADE.

SIR,—Having been constituted a Committee by the Board of Trade, on Dec. 23, 1891, "to inquire into and report to them upon the subject of the Standards to be used for Testing the Illuminating Power of Coal Gas," we have the honour to submit to you the following Report:—

1.—It was intimated to us, by a letter from the Secretary to the Board, that the method at present in use for measuring the illuminative value of coal gas has been objected to, alike by the Metropolitan Gas Referees and the London County Council, as being of an unsatisfactory nature; that the London Gas Companies are alive to the defects in the present system; and that legislation is admittedly necessary for the purpose of substituting a more reliable standard for that now in existence; but that, in view of the difference in opinion as to what the substituted standard should be, the President of the Board deemed it advisable that, before his support was given to any legislation, the whole question should be considered by a Committee that would command the confidence of the various interests affected.

2.—The method at present in use for measuring the illuminative value of coal gas consists in comparing the light of the gas, when burning from a particular burner at a specified rate, with the light of a sperm candle burning also at a specified rate, which last is taken as a standard. We have satisfied ourselves, from considerations set forth in the appendix to this report, that the flame of a sperm candle does not furnish a satisfactory standard, by reason of the amount of light which it affords varying over a wide range, under conditions as to the manufacture of the candle, as to its mode of use, and as to adventitious circumstances attending its use, which, as a whole, it is not possible to regulate and define.

3.—Though recognizing, however, that the sperm candle flame does not furnish a satisfactory standard, we nevertheless consider it advisable that, in official documents and reports, the quantity of light yielded by coal gas burned under specified conditions should continue to be expressed as heretofore, in terms of candle light, the actual comparison,

however, being made between the gaslight and some well-defined and constant light ascertained to be equal in quantity to, or a definite multiple of, the average light given by the standard sperm candle.

4.—We have further come to the conclusion that, in the present state of experience and knowledge, the source of the light to be used as a standard by gas testers generally must be produced by the process of combustion, and be in the nature of a flame.

5.—We find that the 1-candle-light flame proposed by Mr. A. Vernon Harcourt as giving a standard light, and commonly known as the "Harcourt pentane air-gas flame," when used under the conditions defined, does constitute a very exact standard, capable of being reproduced at any time without variation of illuminative value.

6.—We have satisfied ourselves that the light given by Mr. Harcourt's above-mentioned pentane air-gas flame as defined, in respect to the conditions of its production, in the appendix, is a true representative of the average light furnished by the sperm-candle flame constituting the present standard. Since 1879, when the pentane air-gas flame was first introduced, many series of experiments have been made by different observers, in which the light of the proposed standard has been compared with the light of the standard sperm-candle flame, with the result that, in those series of experiments in which the height of the pentane air-gas flame was adjusted strictly according to the directions given in the appendix, the light afforded by this flame was found to agree exactly with the mean result afforded by the standard candle flame. In other series of experiments, indeed, in which a slight variation was made in the mode of adjusting the height of the pentane air-gas flame, some discrepancies in the direct results furnished by the comparison of its light with that of the standard candle flame were observed; but in these several series of experiments also, when the necessary correction, called for by the difference in the mode of adjustment resorted to, was made, the light of the pentane air-gas flame was found to accord closely with the mean result afforded by the standard candle flame.

7.—Inasmuch, however, as there is a practical advantage in comparing directly the light of such a coal-gas flame as is usually tested (being, that is, of about a 16-candle-light value), with a light approximating somewhat in value thereto, we have further submitted to careful examination the flame of the 10-candle-light pentane Argand proposed as a standard by Mr. W. J. Dibdin in 1886. This flame is produced by burning a mixture of air and pentane vapour from a suitable Argand burner, provided with an opaque screen, by which the light from the upper portion of the flame is cut off. The screen being set at a definite height, it was found by Mr. Dibdin that, owing to a compensating action affecting the lower or exposed portion of the flame, the luminosity of this portion of the flame remains constant even under considerable variations, whether in the total height of the flame or in the proportion of pentane vapour to air in the mixture burnt. With a view to simplify the construction of the Argand burner furnishing a cut-off flame of this constant luminosity, we have tried various changes in the form of the cone and in the division of the air supply to the flame, but in every case have found the original burner, as supplied by Mr. Sugg for the purpose, to give more satisfactory results than the modified forms.

8.—The amount of light emitted by the portion of the Dibdin Argand pentane-air flame that is used in photometry being dependent on the distance above the steatite ring of a screen by which the upper part of the flame is cut off, we have come to the conclusion that when the bottom of the screen is fixed at a height of 2·15 inches (54·6 mm.) above the top of the steatite ring, the amount of light emitted by the lower portion of the flame is substantially equal to ten times the average light of a standard sperm-candle flame, or to ten times the light of Mr. Harcourt's 1-candle-light pentane air-gas flame.

9.—We have further satisfied ourselves that any number of Dibdin Argand burners may be produced, having the form and dimensions set forth in the appendix; and that these several burners, when used in the manner there defined, may be depended on to furnish a flame giving, when duly screened at the top, ten times the average amount of light given by a standard sperm candle.

10.—We therefore recommend that the pentane-air flame furnished by a Dibdin Argand burner, having the form and dimensions set forth in the appendix, and used in the manner there defined, be accepted as giving the light of 10 standard candles, and that this flame be authorized and prescribed for official use in testing the illuminating power of the gas supplied by the London Gas Companies.*

11.—We further recommend that sealed specimens of the burner, the carburetter, and the pentane for use therewith, duly certified by the Gas Referees, be deposited with the Board of Trade, and also in such places and in the care of such persons as the Board may direct, to be available for the purpose of comparison, in the event of any question arising as to whether the pentane-air flame of some particular burner does or does not afford the same amount of light as that now proposed for adoption as a standard.

12.—With a view to making some provision for future possible improvements and requirements, we further recommend that the Gas Referees be authorized, should they at any time see fit, to approve and certify for use in gas testing any other flame, based upon the 10-candle standard defined above, which they may consider suitable for the purpose, whether produced in a like or unlike way, and whether having the same or a different multiple value; such other flame, however, not to be used for gas testing unless approved by the Board of Trade, and unless the Gas Companies give their consent to its adoption as a standard.

13.—We further recommend that the illuminating power of coal gas shall continue to be recorded as heretofore in terms of the light given by a specified number of cubic feet (to wit, 5 cubic feet) burnt per hour from the standard "London" Argand burner; but that, in testing the illuminating power of the gas, the requirement that the gas shall actually be consumed at this rate be rescinded, so as to allow the Gas Referees to sanction† a mode of testing in which the gas shall be burned from the standard "London" Argand burner at whatever rate is found requisite in order that it may give a light equal to that of the prescribed number of candles, and in which the illuminative value of the gas shall be calculated as being inversely as the rate at which such gas had to be burned during the testing so as to give this amount of light.

We have the honour to be,

Your most obedient Servants,

(Signed) WILLIAM ODLING, *Chairman.*
W. J. DIBDIN. GEORGE ROSE-INNES.
E. FRANKLAND. A. W. RUCKER.
A. VERNON HARCOURT. W. J. RUSSELL.
GEORGE LIVESEY. G. C. TREWBY.
WILLIAM POLE.

Subject to the omission from 13 of the words "the Gas Referees to sanction."

H. E. JONES.

VIVIAN B. LEWES, *Secretary.*

* See "Technical Record" to-day, p. 1021.

† These words, as will be seen by his note to the report, were objected to by Mr. H. E. Jones.

THE MODERN GAS-ENGINE: ITS DEVELOPMENT AND APPLICATIONS.

By G. E. STEVENSON.

The history of the modern gas-engine commenced with the invention of the Otto motor in 1876; but the most rapid and extensive development has been subsequent to the expiration of the Otto patents. Prior to this, the ingenuity of inventors was chiefly employed in devising methods of construction which, while not infringing those patents, would be of a practical and economical character, affording a prospect of successful competition with the Otto engine.

As regards the latter, its makers had continued steadily to improve the details of the engine, and especially so by the abandonment in 1888 of the slide-valve. This part of the engine was always its weak point; for the slides could never be kept in order for long together, and it was found necessary to supply them in duplicate, in order that the engine might not be standing while they were refaced. This difficulty was obviated by the substitution for the slides of lift-valves, the surfaces of which, not being subject to the same wear, will keep tight for an indefinite period. They also possess the advantage of effecting a much more instantaneous admission than was possible under the old method. Although this improvement did much to encourage the use of the gas-engine as a motor, yet, owing to the protection afforded by the patents covering the Otto principle, and the consequent fact that engines of this type could only be obtained from the licensed makers, the superiority of the Otto cycle was frequently called in question, and new types of engines, claiming advantages over it, were constantly brought before the public.

Before proceeding to indicate the lines on which the modern gas-engine has been developed, it may be useful to describe briefly the principal types of engine which led up to it.

Mr. Dugald Clerk, himself the inventor of an ingenious gas-engine, classified all gas motors under three types: (*a*) Engines igniting at constant *volume*, but without previous compression; (*b*) engines igniting at constant *pressure*, with previous compression; (*c*) engines igniting at constant *volume*, with previous compression. To the first of these types, belonged the Lenoir engine, the Hugon engine, the Bisschop engine, and the Otto and Langen engine. The last of these was a "free piston" engine, in which a vertical piston was driven upwards by the explosion, and in descending, under the pressure of the external atmosphere, engaged with, and revolved, the fly-wheel shaft.

The second type was exemplified in the Brayton engine, which, although never assuming practical importance, was at one time made in an improved form by Messrs. Simon, of Nottingham. In this, the combustion of the gas and air, issuing from the orifice of a separate chamber in which it was previously compressed, was made to take place gradually, and thereby a constant pressure in the cylinder was maintained.

To the third type belong all the more modern forms of gas-engine, in which a constant volume of an explosive mixture, forming the charge, is first compressed, and then exploded in the cylinder of the engine, causing an initial maximum pressure, which is afterwards reduced by expansion of the gases.

This type of engine, previous to the expiration of the Otto patents, was represented by two distinct classes—viz., the Otto engine, in which the cycle of operations in the cylinder occupies four piston strokes, giving an impulse once only every alternate revolution, and those having

for their chief object the realization of a working stroke in each revolution.

The "Otto" is based on what is known as the "Beau de Rochas" cycle, patented in France in 1862. Its sequences are well known; but for the sake of clearness, it may be well to recapitulate them. A mixture of gas and air of definite volume is drawn into the back end of the cylinder by one forward stroke of the piston; at the end of this stroke, the admission-valves are closed; and, on the return stroke, the mixture is compressed at the end of the cylinder, where a certain clearance, or back-chamber, is provided for the purpose. On the next out-stroke, ignition takes place; and the pressure generated by the explosion gives the working impulse to the piston. The fourth stroke of the cycle—viz., the second return stroke—is devoted to expelling the waste products.

Those makers of gas-engines who were not entitled to use the Otto patents endeavoured to solve the difficulty by compressing the charge in a separate chamber, instead of in the engine cylinder. By this means, they were enabled to obtain an impulse at each outward stroke of the piston, inasmuch as the operations of drawing in and compressing the next charge were performed during the active or explosive stroke and the next return stroke of the engine piston. This was the method adopted in Clerk's engine. In the "Robson" engine, made by Messrs. Tangyes Limited, the operations of charging and compressing were performed in the front end of the engine cylinder, which was closed like that of a steam-engine. In the original "Stockport" engine, a second cylinder was used for this purpose; the front end of the trunk of the engine being formed into a second piston working in the charging cylinder. Another engine embodying the same idea was the Atkinson "differential" engine. From all these, results were obtained which made them by no means to be despised as competitors of the Otto; but unfortunately the makers in few instances could escape the charge of infringement of the Otto patents.

Mention must also be made here of the Griffin six-cycle engine. This engine embodied the Otto cycle in the first four strokes, but the fifth and sixth were devoted to drawing in and expelling a charge of pure air, which completely displaced the burnt gases.

With the expiration of the Otto patents, however, the *raison d'être* of all engines on other than the Otto principle fell to the ground. The fact is that the Otto system is at once the simplest and most economical of application; all other types of engine which necessitate separate appliances for the preparation and compression of the charge being more complicated in construction, and more costly to manufacture. At the present day they have all been abandoned; and their makers have adopted the Otto cycle. The recent development of the gas-engine has been essentially on Otto lines, and is, in fact, an approximation of all types to one standard type.

The first requisite in the successful development of the gas-engine being economy in fuel consumption, it is natural that the attention of inventors should have been primarily directed towards the production of greater efficiency. In the earliest gas-engines, one or other of two defects invariably existed. Either their fuel consumption was extravagant, or the power exerted was very small in proportion to their size. The former defect was owing to the fact that the differences of pressure and temperature at the beginning and end of the cycle were small; and consequently little useful effect was developed by the combustible.

Non-compressing engines, of the Lenoir type, worked with low initial pressure and very incomplete expansion. A large amount of gas was subjected to combustion; but a very small percentage of the heat evolved was converted into mechanical work. The efficiency of the Lenoir engine was only 4 per cent. The Bisschop engine and the Otto and Langen engine were more economical, because (although non-compressing) the time and space afforded for expansion were much greater. On the other hand, they exerted a very small power for their size and weight. The introduction of the principle of compression saved the gas-engine from being relegated to that limbo towards which all hot-air engines have hitherto gravitated. It rendered possible the utilization of a much larger percentage of the energy developed by providing the means for extensive expansion of the products of combustion, at the same time that it concentrated the forces at work by producing a higher initial pressure and temperature than were previously possible. With the introduction of the Otto engine, the consumption of gas was reduced to from 25 to 35 cubic feet per indicated horse power per hour. From 1880 to 1890, by modifications in the proportions of gas and air, and other improvements, the consumption was reduced to about 25 cubic feet for the smaller, and 20 cubic feet for the larger engines, per effective horse power. It has, however, been reserved for the past year's improvements to bring about a further marked reduction in the gas consumption by the adoption of what is known as the "scavenging" principle. This principle is not new in itself, having been carried out (as has already been stated) in the Griffin six-cycle engine, which, however, involved the disadvantage of prolonging the cycle by two additional strokes; thus diminishing by one-third the power of the engine. In the original Otto, a portion of the waste gases always remained behind, and, becoming mixed with the succeeding charge, diluted the mixture and weakened the force of the explosion. A slow explosion is manifestly incompatible with a high initial pressure; and the value of the latter having been recognized, an improvement has recently been introduced by Messrs. Crossley, by which the spent products are swept out of the cylinder at the close of the cycle without recourse to two additional strokes of the piston.

This is effected by opening the air-admission valve a quarter of a revolution before the discharge-valve is closed. This latter opens at three-fourths of the semicircle on the forward working stroke, and is not closed until one-quarter of the semicircle on the next forward, or suction, stroke has been performed. It, therefore, remains open for three-fourths of an entire revolution. The air-admission valve opens before the piston has returned to the back end of the cylinder, at three-fourths of the semicircle on the return discharge stroke. A long vertical discharge-pipe is attached to the engine; and the rush of the spent gases up this pipe causes a vacuum, by which air is sucked through the engine and up the pipe, sweeping all the spent products before it. The result of this is that, when the discharge-valve closes and the gas admission-valve opens, the space behind the piston is filled with pure air, and a correctly proportioned mixture is formed, the explosion of which produces an impulse of full and uniform strength at each working stroke. This improvement is the joint invention of Mr. Frank Crossley and Mr. James Atkinson, who is now associated with Messrs. Crossley Bros.

Besides this improvement, an increase in the amount of compression has also been effected. Formerly from 40 to 60 lbs. pressure per square inch was usually obtained in compressing the charge. This is now increased to 80 and 90 lbs. The effect of this, together with the purity of the charge, has been to raise the initial pressure at the moment of explosion to about 300 lbs. per square inch. The accompanying indicator diagrams are taken from a paper

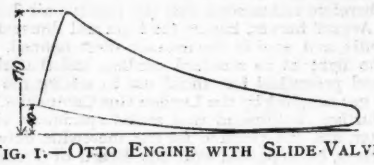


FIG. 1.—OTTO ENGINE WITH SLIDE-VALVE.

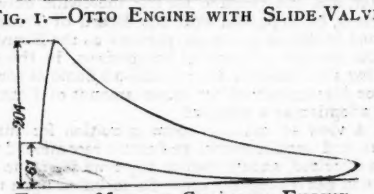


FIG. 2.—MODERN CROSSLEY ENGINE.

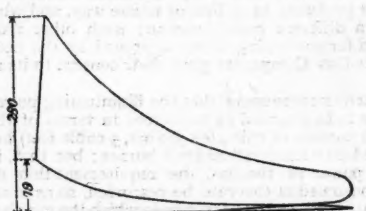


FIG. 3.—NEW "SCAVENGING" ENGINE.

read by Mr. Atkinson before the Manchester Association of Engineers on Nov. 10, 1894. No. 1 is from an old Otto

engine with slide-valve. No. 2 is from a more modern engine, before the application of the "scavenging" principle. No. 3 is taken from a new "scavenging" engine developing 40-horse power effective. No. 4 is from a similar but larger engine worked with Dowson gas. It will be seen that, in the diagram No. 3, the curves, both of expansion and compression, are much quicker, and rise higher, than in Nos. 1 and 2. This proves, first, that the expansion is more rapid and complete, and the initial pressure higher in the newer than in the older engines; and, secondly, that the degree of compression is greater. The explosion is also more instantaneous, as shown by the straightness of the ascending line at the commencement of the working stroke.

In the diagram No. 3, the initial pressure is 280 lbs., and the compression 79 lbs.; the mean pressure throughout the stroke being 98·75 lbs. In No. 2 diagram, the mean is 68·1 lbs., with a maximum of 204 lbs., and a compression of 61 lbs. In No. 4 diagram, the initial pressure is 320 lbs. and the compression 90 lbs. The economy

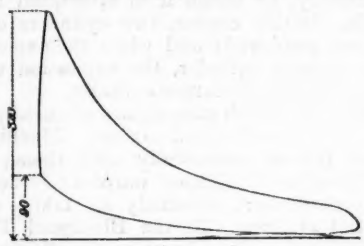


FIG. 4.—NEW "SCAVENGING" ENGINE WITH DOWSON GAS.

resulting from these improvements is remarkable. The gas consumption in the new engine is reduced to 16·48 cubic feet per effective horse power, as against 23·87 cubic feet in the older engines.

The actual efficiency of the new engine is stated by Mr. Atkinson to be 28·26 per cent., as compared with 22 per cent. actual efficiency in those of the older type. It may here be stated that by *actual* efficiency is meant the ratio of the heat converted into work to the total heat developed by the combustion of the gas. When coal gas is used, some 6 per cent. is required to be deducted to arrive at the net heat-effect utilized from the coal. The *mechanical* efficiency is the ratio of the effective, or brake, horse power to the indicated horse power. This, in the best engines, has been brought up to 86 per cent.—that is to say, that 14 per cent. only of the power exerted is spent in working the engine itself. Of course, that only applies when the engine is working at full power, because the friction load is a constant one.

Improvements in valve and governing gear have played an important part in the development of the modern gas-engine. The substitution of independent lift-valves for the old slide has already been referred to. This enabled makers to work the gas and air admission separately, and so better to regulate the proportions of gas and air forming the explosive mixture. In the modern engine, the air is admitted at every cycle without alteration; and only the gas supply is interrupted by the governor. The governing of the Otto engine has always been effected by Messrs. Crossley Bros. on the "hit-and-miss" principle. In the older engines the governor, which was of the centrifugal type, determined whether or not the gas-valve lever should be struck by the cam on the side shaft. Two types of governors are used in the later engines—a centrifugal for the larger, and an "inertia" governor for the smaller sizes. In the largest engines, a lever carrying a roller and a steel blade is actuated by a cam at every revolution of the side shaft; and a disc is moved by the governor in a vertical direction into such a position that, when struck by the blade, it opens the gas-valve. When, by increased speed, the governor rises, the position of the disc is so altered that it is not struck by the blade, and the valve remains closed. A modification of this plan is adopted with engines of moderate power. The governor moves, in a horizontal direction, an edged roller, set loose on a spindle, which is attached to a bell-crank lever actuating the gas-valve; and according to the position into which the disc is moved by the governor, it is struck, or not, by a narrow step on the cam of the side shaft. The inertia governor applied to small engines consists of a small weight and blade, pivoted on a bell-crank lever, which tends to lag behind as the engine increases in speed, and hits or misses the valve-spindle. Means are adopted, in addition, whereby the discharge-valve can be opened at every in-stroke of the piston, so as to do away with compression at starting. The cam actuating the discharge is made to slide on the shaft; and at one side it has a narrow projection or step, forming a secondary cam opposite the primary one. When, by moving a lever, the cam is shifted to the starting position, the secondary cam acts on the discharge as well as the primary one.

The governing of the engines made by Messrs. Tangyes Limited, is done by the movement of a roller along a pin on the gas-valve lever, which brings it opposite a grooved cam on the side shaft of the engine. In order to prevent slipping of the gas-valve—*i.e.*, partial contact between the cam and the roller, and subsequent slipping off of the latter—a second (knife-edged) cam is used, which, coming in contact with a knife-edged collar on the roller, fixes its position, when opening the gas-valve, exactly opposite the cam.

The abandonment of the "slide" necessitated an alteration in the method of ignition. Messrs. Crossley Bros. introduced the system of "tube igniters." These were first made of wrought iron, closed at the upper end, and placed vertically in a cylindrical casing. The lower end communicates with the cylinder; and the tube is kept red hot by the flame of a Bunsen burner. These tubes have a short life, and become corroded, so that the heat of the flame is unable to penetrate the metal and keep it sufficiently hot to ignite the charge.

Messrs. Crossley experimented with tubes of cast iron, nickel and platinum alloys, and other mixtures; but they have finally adopted porcelain tubes, which, while possessing the advantages of being quickly heated, and of costing little for renewal, are practically indestructible by heat. They are now generally placed horizontally in a rectangular casing, one end of the tube fitting over a nozzle communicating with the cylinder, and the other closed by a pin held tight by a screw or spring.

An important feature in the modern igniting arrangements is the "timing" valve. This valve opens communication with the cylinder at the moment when ignition is required, and allows a small portion of the charge to be injected into the tube, whence it fires-back and explodes the charge. Some makers dispense with the "timing" of the valve, and make it open automatically by the pressure of the charge. Under these conditions, however, it is difficult to prevent premature ignitions, which may cause a very severe strain to be thrown on the crank-shaft and cylinder of the engine. French makers of gas-engines mostly adhere to ignition by the electric spark, which was the method adopted in the Lenoir engine.

The development of gas-engines is in nothing more marked than in the increase of their size and power. Many single-cylinder engines are now being made in this country of 100-horse power effective. Messrs. Tangyes have just completed one large single-cylinder engine indicating 180-horse power with Dowson gas. They have also lately made one with a cylinder 24 inches in diameter and a stroke of 30 inches, to run at 150 revolutions per minute, with a piston speed of 750 feet per minute. The trials of this engine with producer gas have given an indicated horse power of 196; and with Welsh anthracite coal, a fuel consumption not exceeding 0·8 lb. per indicated horse power can be guaranteed. Messrs. Tangyes inform me that they have no doubt whatever that ¾lb. will be the maximum consumption of fuel per indicated horse power in the future. The exhaust-valve would require to be of such large area, as it would have to lift against a terminal pressure of 40 lbs. per square inch, that the strain upon the pins, levers, and cams would be very great; and it was considered advisable to use two valves instead of one, the areas of which are in the proportion of 2 : 1. Both valves are actuated by the same lever; but the smaller one is raised first, and held up for a little time to reduce the pressure before the large valve rises.

Another engine has lately been constructed by Messrs. Dick, Kerr, and Co., of Kilmarnock, of 270 indicated horse power (with Dowson gas); but this is a double-acting engine. On the Continent, the firm of Matter, in Rouen, has constructed a single "Simplex" engine of 300-horse power, devised by MM. Delamare-Debouteville and Malandin, which does not, however, differ in principle or design from the regular Otto type.

In large engines, the opening of the heavy gas-valves

used with producer gas causes excessive wear on the narrow-edged cams. To obviate this, Messrs. Tangyes have adopted in their latest engines a method by which the gas-valve lever actuated by the cam does not act direct on the valve-spindle, but does so through a tumbler which is kept out of gear by a spring or weight. One end of a light secondary lever is connected to the tumbler, and the other end is provided with a roller sliding on a pin, and moved by the governor as in the ordinary-sized engines. This roller is actuated by the usual grooved cam; and the main gas-valve lever by a broad cam at every revolution of the side shaft, in the same way as the air-valve lever. The secondary lever brings the tumbler into position, so that the main lever can raise the valve.

The demand for large engines has rendered necessary the application of self-starting gear. Engines up to 12-horse power nominal can be easily started by hand; but above this power, starting appliances are desirable, and in large engines are absolutely essential. There are several ingenious methods adopted, all of them having for their object the introduction of an explosive mixture into the cylinder (either with or without compression), and, by the firing of this charge, the starting of the engine. Messrs. Crossley use a hand pump to charge a receiver; and when communication is opened between this and the cylinder, the mixture enters, and replaces the air previously contained therein. A few strokes of the pump raise the pressure to about 1 lb. above the atmosphere; and the mixture is then fired at the receiver, and the combustion propagated in the cylinder.

Messrs. Andrew, of Stockport, employ a different method. In their engines, gas is introduced into the cylinder through a small valve kept open by a spring. The gas displaces part of the air, and in due course forms with the remainder an explosive mixture, driving out the air before it, which, on passing through the incandescent tube, fires-back and starts the engine. The pressure of the explosion automatically closes and locks the spring valves by which the gas is admitted, and the air, &c., discharged. In Messrs. Tangyes' engines, Pickney's self-starter is used. By this method, an explosive mixture is introduced under pressure into the cylinder—the crank being prevented from revolving by a spring, which releases it when ignition occurs. The degree of compression is regulated by a safety-valve on the pump.

In starting large engines, or when it is required to start several engines at once, Messrs. Tangyes now use a mild steel reservoir, into which the explosive charge is pumped to a pressure of 80 lbs., and from which the cylinders are charged. Messrs. Fielding and Platt use a small reservoir, which is charged with compressed air only. In starting, a charge of gas is introduced into the cylinder, and air from the reservoir is mixed with it—thus forming a compressed mixture. The charge is fired at the igniting-tube after the piston has commenced to move under the influence of the compression. Messrs. Dick, Kerr, and Co. have departed from the plan followed by most makers in their large engine, which is started by steam from the small boiler used for making Dowson gas.

The construction of double-cylinder engines has been a source of some diversity in form. Messrs. Crossley Bros. first commenced in 1890 to make pair-cylinder engines, with double cranks placed at an angle of 180° to one another. The cycles in the two cylinders being alternate, an impulse was obtained at each revolution—first in one and then in the other cylinder. This plan has now been relinquished in favour of placing the cylinders with the pistons facing one another, and working on one crank. In this form there is less strain on the crank-shaft; but the impulses are not so equally divided, inasmuch as two working revolutions succeed one another, and are followed by two negative revolutions.

Messrs. Andrew and Co., in their latest large engine, have adopted the "tandem" form. The cylinders are placed one behind the other, the piston of the hindermost cylinder working, by means of crossheads and coupling-rods, on the same crank as that of the forward cylinder. The cycles are alternate; and an impulse is obtained at each revolution from one or the other cylinder. This engine is of 400-horse power effective (200-horse to each cylinder). It was made for Messrs. Henry Spicer and Sons, and is erected at their paper-mills at Godalming.

It has been stated that the recent development of the gas-engine is an approximation to one standard type. While this is so in the main, there are some singular exceptions. The double-acting engine of Messrs. Dick, Kerr, and Co. is an attempt to reduce the form of the gas-engine to that of the steam-engine. In this engine, the cylinder is closed at both ends, and has a piston-rod in all respects similar to that of a steam-engine, passing through a stuffing-box in the front cylinder cover. The engine works on the Otto cycle at both ends of the cylinder; and its action is identical in effect upon the crank with that of the end-to-end double-cylinder engine of Messrs. Crossley Bros.

Messrs. Scott Bros., of Halifax, are the makers of what is called the "Duplex" Otto engine. This engine has two pistons working in opposite directions in one cylinder, under one and the same impulse. The back piston acts by two side connecting-rods, on cranks placed at 180° with that of the forward piston. So far as the author is aware, no compound engine has yet been made in this country; but Professor Aimé Witz, in his latest volume on the gas-engine,* describes one invented in America, bearing the name of Connelly, in which it is attempted to embody this principle. In this engine, two cylinders of different dimensions are employed; and while the explosion takes place in the smaller cylinder, the expansion of the products is completed in the larger cylinder.

The purposes for which gas-engines are used are becoming rapidly more extended and various. Machinery of all kinds is now driven successfully with them; and their application for electric lighting purposes is becoming an important consideration, especially for taking up the day load in central stations. At the Blackpool Tower, gas-engines to the extent of 500-horse power effective are used for electric lighting; and at the new Midland Railway Station at Leicester, gas-engines in the aggregate of 300-horse power have been put down for the same purpose.

Gas-engines are used at the Birmingham Water-Works for pumping purposes; and Messrs. Crossley have on hand, for the River Wear Commissioners, a set of three high-speed engines, each 120-horse power effective, for driving centrifugal pumps, to which they will be coupled direct. A similar set of engines is being made by Messrs. Tangyes for the same purpose.

Gas-engines have already been tried in this country for driving tramway locomotives; and on the Continent there are several instances where they are successfully applied for this purpose. They have also been used for propelling boats; and a company has been formed at Havre to work boats on the Seine with gas-engines—the fuel being ordinary town gas compressed in cylinders.†

The number of gas-engines actually in use at the present day is hardly to be realized unless special attention is given to the subject. Messrs. Crossley have turned out 24,400 Otto engines; Messrs. Andrew give 7000 as the number they have manufactured; while the German Otto Company have made some 8000 motors. At the present day, there are a dozen or more makers of Otto engines in this country alone. In Manchester, at the close of the last financial year, there were 966 gas-engines on the books of the Gas Department; and the consumption due to these engines in the year was 123 million feet.

So far as the smaller engines are concerned, every addition to the purposes for which stationary gas motors are used means an increase in the business of the gas manufacturer; but, under present conditions, this is not so with regard to large engines. So long as gas is sold in our towns at the usual lighting rates, large engines will be more cheaply worked with Dowson gas. Messrs. Crossley state that it costs them 2½d. per 1000 cubic feet to make Dowson gas; and they require to use five times as much of it as of Manchester city gas to produce an equal horse-power effect. According to this, it would be necessary to sell town gas at 12½d. per 1000 cubic feet in order to compete with Dowson gas; but inasmuch as other advantages ensue from using gas of high calorific value—such as reduced size of engine, and less cost for attendance and wear and tear—the author believes that at a price of 1s. 6d. per 1000 cubic feet town gas would be used in preference to Dowson gas. He is supported in this opinion by the fact that at Sunderland, where gas is supplied very cheaply in large quantities, many high-power engines at the docks and elsewhere are

* A notice of this work appeared in the JOURNAL for Jan. 1 last (p. 19).

† For particulars respecting this system of utilizing gas, see *ante*, pp. 479, 847.

working with town gas. At the engineering works of Mr. John Dickenson in that town, ten gas-engines, of an aggregate of 400-horse power effective, are supplied with town gas at 1s. 6d. per 1000 cubic feet; and the proprietor says there is a considerable saving over the use of the steam-engines which he formerly employed.

At Messrs. Andrew's works at Stockport, a gas-engine of 100-horse power indicated drives the workshop machinery. It is fed with Dowson gas, and can develop 67 brake horse power; but its present load does not exceed 40-horse power. The Dowson producer consumes from 26 to 28 cwt. of Welsh anthracite coal, at 22s. 6d. per ton delivered, per week of 60 working hours. Taking the mean consumption at 27 cwt., the consumption per horse power per hour works out at 1·26 lbs. The cost of working this engine will be as follows: 27 cwt. of coal, £1 10s. 4½d.; attendant for producer, £1 5s.—total, £2 15s. 4½d. If fed with town gas, the consumption would be 20 cubic feet per horse power per hour, or 48,000 cubic feet for the 60 hours. At 1s. 6d. per 1000 cubic feet, the cost would be £3 12s. per week. No attendance would be chargeable, as the engine, once started, will work on all day with occasional inspection in connection with the water circulation and oil-feeds. The difference of 16s. 7½d. per week is certainly not too much to allow for the repairs to, and interest on, the Dowson plant. If, instead of this unnecessarily large engine, one of 40-horse power were employed, with a gas consumption of 16½ cubic feet per horse power, the fuel consumption would not exceed 40,000 cubic feet per week, costing, at 1s. 6d. per 1000 cubic feet, £3, or very little more than the cost of working the Dowson plant.

Much may be done, in the author's opinion, by the owners of gas-works, to encourage the use of gas-engines, by employing them for their own purposes. It is at present the exception rather than the rule to find them used in gas-works. In small works, the principal thing for which power is required is driving the exhausters; but in few instances are gas-engines used for that purpose—one reason being that variations of speed are difficult to provide for. It might, however, be worth inquiry whether some convenient appliance could not be devised for varying the speed of the exhauster while that of the engine remained constant. There are, however, other purposes for which gas-engines can be used with advantage on gas-works, such as driving pumps, elevators, and other machinery.

An arrangement has been adopted by the author at the Rochdale Road station of the Manchester Gas-Works, for a twofold purpose—viz., driving purifier elevators, and working machinery in the carpenters' shop. Two 10-horse power nominal Crossley engines are fixed side by side, and drive pulleys fitted with cone-clutch gearing, so that they can run fast or loose as required. An intermediate pulley, also fitted with clutch gearing, drives the machinery in the carpenters' shop overhead; while an underground shaft, gearing into the end of the main shaft, drives the elevators, which are in a building on the other side of a roadway. Either or both of the two engines can be used, as is found necessary. The cone friction clutches are worked by levers actuated by screws fitted with hand-wheels; and by these means, any part of the work can be put into or thrown out of gear while the engines are running.

Petroleum oil-engines are not of interest as affecting the gas industry directly; but any notice of gas-engine development would not be complete without some reference to them. In all essentials they are gas-engines; and their development has proceeded together with, and much on the same lines as, that of gas-motors. To Messrs. Priestman Bros., who first devised a practical means of vaporizing the oil, and mixing it in an explosive form with the air, must be attributed the success of the oil-engine. At the present day, most of the makers of gas-engines also manufacture oil-engines, besides some firms who make a speciality of the latter. Such a speciality is the Hornsby-Akroyd oil-engine, made by Messrs. Hornsby and Sons, of Grantham. The peculiarity of this engine is that the ignition of the charge of air and petroleum vapour is effected spontaneously by the compression of the charge, which, rendering sensible the latent heat of the already highly-heated mixture, thereby raises the temperature to such a point that (spontaneous) combustion occurs.

Such progress has of late years been made in the construction of oil-engines that, at the last meeting of the Royal Agricultural Society at Cambridge, 15 oil-engines competed in a three days' trial; and the results showed a consumption of 0·9 lb. to 1·15 lbs. of oil per brake horse power—the cost of the fuel being a little more than 0·4d. per horse power per hour. The efficiency in the best engines was 19 per cent. It may be taken as probable that oil-engines will henceforth assume considerable importance as agricultural motors, for which purpose they are peculiarly adapted.

In conclusion, the author desires to place on record his indebtedness to Mr. D. H. Irwin, the Managing-Director of Messrs. Crossley Bros., to Mr. A. R. Bellamy, the Manager of Messrs. J. E. H. Andrew and Co., of Stockport; to Messrs. Tangyes Limited, of Birmingham; and to other firms who have supplied him with valuable information for the preparation of this paper.

ON THE TEMPERATURES EMPLOYED IN THE DISTILLATION OF COAL.

By Lewis T. Wright.

The author has on several occasions endeavoured to obtain information respecting the temperatures to which coal is submitted in clay retorts during its distillation as in gas-works practice; and for this purpose he has made observations of the working of clay retorts under various circumstances. As the statement of the results is in some measure related to the volume of gas yielded by the coal, it would perhaps add to their value if some information could be afforded concerning the soundness, as against loss of gas by leakage, of the clay retorts employed.

There can be no suspicion, in the case of the experimental iron retort, of such loss of gas as might be feared in the case of "clays;" and it might at first sight appear possible to make use of the results obtained with any coal in iron retorts as a criterion of what the same coal should produce in clay retorts if there were no leakage of gas from these latter, and then to arrive at the efficiency of these in terms of the result obtained with the experimental iron retort. But the volumes obtained in the one case and the other cannot be thus compared, since the volume of gas produced is sensitive to differences in the temperature to which it may be submitted; and as it would never be certain, in the one case and the other, that the same mean and effective temperature had been employed, there can be no comparison. Thus, so far, there is not any possibility of making use of the result obtained from an iron retort as a standard of what might have been the loss of gas from the same coal when distilled in clay retorts.

It might be thought that the illuminating power, which in a general way decreases with increased volume production per unit of coal, with increased rapidity of gasification, and with increased temperature exterior to the retort, might be used as a measure of the temperature; and that the yields of gas from the two kinds of retorts might be compared on the basis of the same illuminating power, and the loss from the clays, if any, arrived at by these indirect means. It would be a simple operation to conduct a trial of clay retorts, noting the volume of gas and the illuminating power, and then to find in the experimental retort the volume produced with a similar quality of gas, and in that manner to obtain a factor of efficiency for the clay retorts.

The author does not, however, propose to make a comparison between the results obtained with iron and clay retorts on this latter basis, which may be termed, for convenience, the basis of equal illuminating power, since he believes that the results obtained with the experimental iron retort are not to be compared with those obtained with clay retorts as in gas-works practice, because the gas, after being produced in the retort, is very differently treated in the two cases.

In the works, the gas is washed free from ammonia with a certain quantity of clean water that removes from the gas some of its illuminating value. The average of an extensive inquiry into the amount of this loss of illuminating power, in which 118 tests were made on the inlet, and an equal number on the outlet, of the scrubbing apparatus, brought out the fact that there was an average loss of about 2 per cent. in illuminating power due to the scrubbing operation. From this and other considerations, the author is of the opinion that the results, as obtained with the small experimental iron retort and testing apparatus, cannot be fairly compared with those obtained in

gas-works practice, since the gas is somewhat differently treated in the two cases.

These considerations, therefore, induced the author to determine the soundness of the clay retorts by direct means; and he has for many years been in the habit of testing with a gas-meter the clay retorts used for experimental purposes, under pressures similar to those that are likely to obtain in practice. The results have been generally concordant. The clay retorts used for trials have been free from perceptible holes, and covered with carbon.

The following results may be quoted:—

Tests extending over Six Hours.

Pressure of Gas.	Loss of Gas per Foot Super. of Retort per 24 Hours. Cubic Feet.
(A) 10-10ths	2·46
(E1) 10-10ths	2·59
(E2) 5-10ths	1·46

Tests of Half an Hour.

(F1) 10-10ths	3·20
(F2) 5-10ths	1·53

The same Retorts as in A after being Scurfed.

	Cubic Feet.
5-10ths	7·10

Other Retorts, Eighteen Months in Use, and recently Scurfed.

	Cubic Feet.
10-10ths	13·60
5-10ths	6·80

The average pressure on the clay retorts when at work would not exceed 3-10ths. During the first few minutes after closing the retort-lids, there is an excess of pressure which the exhauster soon corrects; and the author does not think the loss of gas from clay retorts in good working order is at all important.

It is known that furnace gases are very sensitive to coal smoke, as may be seen by placing a little coal in one of the furnaces, or in cases where retorts that have been recently scurfed are put to work; or if there is a retort with a hole in it, or if an extraordinary pressure be put upon the retorts, the chimney exit will show signs of smoke. In good practice, however, the exit is generally free from smoke. This observation, and the results obtained by direct testing also, lead to the conclusion that there need be no important leakage of gas through the retorts into the flues.

Retort Temperatures.

In the case of the distillation of a substance in a closed vessel, a higher temperature must be externally applied than that requisite for its gasification, or there would be no passage of heat through the walls of the containing vessel. The quantity of heat that passes through is directly proportional to the difference of temperature. Thus, for instance, if it be desired to distil the substance at double any given rate, it will be necessary to double the difference between the exterior and interior temperature, in order that double the heat may pass through the separating wall of the containing vessel; and in order to distil the coal at a convenient rate, it may be necessary to have a very considerable difference of temperature between the inner and outer sides of the retorts.

The author believes that the simplest way of regarding the complex problem of the influence of temperature in the distillation of coal, will be to assume that there is a necessary minimum temperature x at which the gas can be expelled from the coal. The action of heat on gases in the case studied is not only mechanical in the sense of volatilizing and expanding, but is also chemical; since, when the gases in question are heated beyond certain temperatures—in this case beyond x—there are chemical decompositions and molecular rearrangements set up that absorb heat.

In discussing this subject, the temperature at which the volatile constituents of the coal become gas will be considered as x, or the lowest temperature at which the coal could be carbonized, and any higher temperature applied to the gas will be considered as superheating it, and producing decomposition and chemical change other than that necessary to separate the gas from the coal; for the action of heat in such a case is not only mechanical, in so far as it expands the gas, but is also chemical, in so far as it tends to break up the compounds formed at a lower, and form others more stable at the higher, temperature.

The coal in the retort is not of uniform temperature. Some is in contact with the sides of the retort, and receives its heat by conduction; other portions of the mass of coal receive heat by radiation through the gas that surrounds it. The author will adduce evidence, which general experience will be found to confirm, that the mass of coal, while it is evolving gas in the retort, is not of uniform temperature; there being hotter and colder zones of temperature in the same retort. It does not necessarily follow that the flowing stream of gas in the retorts is not at all superheated by the radiant heat, as, since it contains solid carbon particles in suspension, these will arrest some of the radiant heat pouring in from the sides of the retorts, and the gas will be heated by contact with these solid particles. The gas, in flowing through the retort, is also partly brought into contact with the hot sides of the retort, and becomes superheated by conduction. But it is hardly probable that the moving stream of gas, when it is being rapidly evolved, can have the same temperature as the hottest of the heated solids (either a hot zone of partially carbonized coal, or the sides of the retorts) with which it is momentarily in contact; for, if these be of higher temperature than x, they cannot raise the temperature of those particles of gas with which they are in contact, without producing chemical changes that would render some portion of the heat insensible—leaving only a portion of what had been received by the gas for the purpose of raising its temperature to that of the solid bodies in question. Time is an element in these changes; and the extent to which the gas is superheated is dependent upon the time of contact, or, in other words, upon the velocity of the gas in its passage through the retorts—a velocity that is nearly 5 feet per second when the maximum evolution of gas is taking place, and the temperature in the flues is very high.

If, owing to the high temperature in the flues surrounding the retorts, heat is being poured into the coal very rapidly, the evolution of gas and its velocity in the retort will be increased, and the gas will be therefore less exposed to superheating. The increased heat flowing into the coal is the result of an increased temperature of the sides of the retorts; and from this cause there will be a greater tendency towards superheating the gas and the production of a larger yield per ton of coal.

There are thus two opposing influences produced by an increased flue temperature—one tending to superheat the gas, and to produce changes in its composition attended with increase in permanent volume, and the other tending to increase the rate of evolution of the gas from the coal; and as its velocity is thereby increased, there is a limitation of the tendency towards superheating.

The author has endeavoured to find the relation between the following:—

(1) The temperature surrounding the retorts, or flue temperature.
(2) The temperature in the retorts during the distillation process.
(3) The maximum rate of evolution of the gas per unit of retort heating surface.
(4) Average rate of evolution during the whole extent of charge per unit of retort heating surface.
(5) The quantity of coal distilled per unit of retort heating surface.
(6) The illuminating power of the gas at various times during the charge.

(1) *Temperature in the Flues.*—For the determination of temperatures not much exceeding 1600° Fahr., the author has employed such pyrometers as Murrie's, or others depending upon the expansion of metals; but for higher temperatures, he has depended upon the observation of the melting-points of metals, such as: Silver, 1749° Fahr.; copper, 1929° Fahr.; cast iron, 2100° Fahr. This method, while it has the disadvantage of only proceeding by large steps of temperature, has the advantage of being independent of the alteration of the value of the scale temperature to which dial pyrometers are liable. The melting-points of metals are constant; and the fact that a certain metal has been melted is evidence that a certain temperature has been reached. The flue temperatures were generally observed at two points—under the crown of the retort-bench arch, and in the side flues at the bottom of the retorts.

(2) *The Retort Temperature.*—It must be remarked that, when the retort is charged and the coal is giving off gas, there is not an even temperature obtaining throughout the retort—there are zones of higher and lower temperature. This want of uniformity in the temperature in

different parts of the retorts of a particular setting makes the determination of the temperature more difficult, as the temperature must be observed at various points in order to obtain an average. This want of uniformity of temperature is partly due to the manner in which the coal is packed in the retort, and partly to the walls supporting the retorts, as well as differences in the temperature of different flues. This want of uniformity in the temperature is well illustrated by the appearance of retorts when being heated up. Dark rings are observable where the supporting walls surround the retorts. In the case of retorts opened for any reason during the charge, it is noticed that the temperature throughout the entire length of the retort is unequal; and very often, on drawing retorts otherwise well "burnt off," a dark patch will be seen, due to a mass of coal from which the gas has not been quite expelled. If, also, a long piece of iron gas-piping, closed at one end, be passed through a hole in the retort-lid to the distilling coal, with the open end in the air, a good sight-hole will be secured, through which can be distinguished with precision the various local shades of temperature in the retort. This form of sight-hole for viewing the interior of the retort is very useful; and the author would recommend it to his colleagues.

In order to observe retort temperatures, in addition to pyrometers, the method of noting temperatures by the fusing of a series of salts of known melting-points was adopted; and the iron gas-tubing before mentioned was made use of for this purpose. The salts employed were: Potassium iodate, with a melting-point of 1040° Fahr.; potassium iodide, 1173° Fahr.; calcium chloride, 1339° Fahr.; sodium chloride, 1429° Fahr.; and sodium sulphate, 1589° Fahr. These salts were passed down to the bottom of the iron tube in a suitably prepared arrangement of platinum "boats." The point when the end of the iron tube was first visible was also noted, and the temperature recorded as 977° Fahr. These salts are examined from time to time—generally at intervals of 5 to 15 minutes. There is, therefore, some degree of uncertainty as regards the exact moment when the salts have melted; but there is, in the case of any salt having been melted, a certainty as regards that temperature having been reached. It often happens that the end of the iron gas-tube is not visibly red hot until the forward part nearer the mouthpiece has been glowing for some time, and *vice versâ*. The temperatures during a trial were generally observed at three different points. There is also to be taken into account variations in the quantity of heat passing into the retorts at different periods during a charge—variations due to differences in the surrounding flue temperatures.

That the contents of a retort are sensitive to such variations, is proved by a fact often observed by the author in his trials—that the effect of charging a retort immediately below that one in which the temperature observations were being made by a dial pyrometer has been to produce a fall of temperature in the upper retort of 15° to 20°.

(3) *The Maximum Rate of Gas Evolution.*—The meters recording the gas made were read at intervals of 15 or 30 minutes; and the results are in all cases calculated to cubic feet of gas per superficial foot of internal retort surface per 24 hours. The maxima referred to in the tables in the appendix are, of course, the largest quantities observed in any interval, calculated to a uniform standard.

(4) *The Average Gas Evolution during the Charge.*—This is, of course, obtained from the total gas produced during the charge, calculated to the usual standard of cubic feet of gas per square foot of retort surface per 24 hours.

(5) *The Quantity of Coal Carbonized.*—For the sake of convenience, this is calculated per 1000 square feet of retort heating surface per 24 hours.

(6) *The Illuminating Power.*—This was taken with the "London" Argand against the Methven standard of 2 candles. The gas was consumed to nearly smoking-point; and the quantity was noted and reduced to the rate of 5 cubic feet per hour.

The author, in the course of various inquiries, has been led to the following observations, the discussion of which must, however, be reserved for another occasion. The illuminating power and the volume of the gas produced at various stages being known, one can calculate an average illuminating power for the whole bulk. This result may be termed the average from the partial illuminating power. Or the whole of the gas may be collected, and, when uniformly mixed, may be tested. This is the illuminating power of the bulk. The two results are not the same.

Effect of Increased Rapidity of Distillation.

Series K (*vide* appended tables) covers the widest range—commencing, as it does, with only 5·4 tons of coal carbonized per 1000 square feet of retort surface per 24 hours, and extending to 14·7 tons. The coal used in this series is a Derbyshire caking coal of not very fine quality as regards illuminating power; being in this respect distinctly inferior to the coals used in Series A and B. It will be observed that the lowest yield of gas was 8429 cubic feet per ton, with a gas production of 49 cubic feet per square foot of heating surface per 24 hours. The yield of gas per ton goes on increasing in a fairly regular manner with increased rapidity of distillation up to 12,190 cubic feet, and a gas production of 126 cubic feet per square foot of retort surface; and after that maximum is reached, it will be seen that the yield of gas per ton of coal falls to 11,331 cubic feet, with an average gas production of 166 cubic feet per square foot of retort. It will be remarked that the gradations of the yield per ton with the rate of gas production do not always correspond in an absolute manner, though, of course, there is, in a general way, a very clear relation between the two.

The carbonization of coal is by no means a simple problem, since the same average rate of gas production may be accompanied by various degrees of heating during the charge. It may be that the temperature is low at the commencement of the charge, but that later on the heat increases; or the reverse may be the case. The retort temperatures show that, at a low rate of distillation, practically all the gas comes off below 1340° Fahr. At the highest rate of distillation, 66 per cent. of the gas was evolved at and below a temperature of 1339° Fahr. When the yield of gas per ton was under 9000 cubic feet, the temperature in the bottom flue did not exceed 1580° Fahr.; though when the temperature in that part of the setting went up to 1680° Fahr., the yield rose to 9378 cubic feet per ton. At and above an average gas production of 118 cubic feet per square foot of retort, cast iron could be melted (+ 2100) in the top flue, and silver in the bottom flue (+ 1749).

In Series A, which was carried up to a high rate of distillation equal to 13·6 tons of coal per 1000 square feet of retort surface per diem, the falling away in the yield of gas per ton in the coal distilled at the fastest uniform rate is believed to be normal. It would appear at first sight, judging from the maximum observed and average rates of gas evolution, that in the case of result 1 A, with a yield of gas per ton of 10,820 cubic feet, the coal was distilled at first rather more slowly than would be usual with the duration of the charge observed. But an inspection of the details will show that this was not the case, and that the result, if judged by the percentage of the total gas evolved in different times (rate per cent. per second), offers a similar case to that observed in Series K—viz., of a fall in the yield per ton when a certain rate of distillation has been exceeded.

While the time required to distil a given charge can readily be ascertained, it is not possible by direct means to know what proportion of coal has been distilled at any time when the distillation is incomplete. In default of that knowledge, it will be assumed that the proportions of total gas evolved in various times during the charge, represent the proportion of total coal distilled in that time.

For that purpose there has been added to the details of Series A the average rate per cent. per second of the total gas evolved in certain observed times; and it will be noticed that the most rapid distillation of the series—viz., 1 A—as also the most uniformly rapid, did not yield the most gas per ton. Up to a distillation of 66 per cent., 5 A, with 11,570 cubic feet per ton, exceeds 1 A, with 10,820 cubic feet per ton. But it will be remarked that, after 130 seconds, the distillation proceeds more slowly; so that, when three-fourths of the gas has been distilled, the average rate of distillation is less than in the case of 1 A. In the case of the slowest rate of distillation of this series, silver did not melt in the bottom flue. The yield of gas was 10,226 cubic feet per ton.

In the case of Series B, all trials were at high rates of distillation—ranging from 12·7 tons to 15 tons of coal per 1000 square feet of retort surface per diem. While there is in this series no decided falling away in the yield

per ton, as was noticed with Series A and K, yet there is no tendency to increase of volume; and the author believes that, if similar trials could be carried out with rates of coal distillation very much higher than those now described, it would be found that the more rapid rate of distillation would not be attended by any marked increase in the yield of gas per ton, but that in some cases even a decrease would result, as the more rapid evolution of gas and its increased velocity would protect it against the destructive action of the increased flue temperature.

These experiments also serve to show, even in the case of high rates of distillation, that the larger portion of the gas comes away when the coal is below the temperature of 1340° Fahr.

Appendix.

Series A.

Number of Trial.	Duration of Charge in Hours.	Gas Yielded per Ton of Coal in Cubic Feet, corrected to 60° Fahr. and 30" Bar.	Cubic Feet of Gas per Foot Super. of Heating Surface. Maximum.	Cubic Feet of Gas per Foot Super. of Heating Surface. Average during Charge.	Tons of Coal Carbonized per 1000 Feet Super. of Heating Surface.	Flue Temperature. Deg. Fahr.		Percentage of Gas evolved at 1339° Fahr.
						Top.	Bottom.	
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
4 A	6·1	10,226	180	119	11·6	+ 1929	− 1749	76·0
2 A	6·0	11,126	187	132	11·8	+ 1929	+ 1749	72·3
3 A	6·0	11,270	250	133	11·8	+ 1929	+ 1749	70·6
5 A	5·4	11,570	233	153	13·2	+ 2100	+ 1749	77·0
6 A	5·3	11,835	244	160	13·5	+ 2100	+ 1749	62·0
1 A	5·2	10,820	211	148	13·6	+ 2100	+ 1749	76·0

The signs *plus* (+) and *minus* (−) indicate that the temperature was higher or lower than the temperature given.

+ 1749° indicates that silver could be melted, but not copper.

+ 1929° indicates that copper could be melted, but not cast iron.

+ 2100° indicates that cast iron could be melted, but not steel.

Col. IV. gives the maximum evolution of gas per superficial foot of retort heating surface (measured inside the retort), calculated per 24 hours, from half-hourly observations.

Col. V. gives the average quantity of gas per superficial foot of retort heating surface (as above), calculated per 24 hours.

In Cols. VII. and VIII. the signs + and − indicate that the temperature was higher (+) or lower (−) than the temperature given (melting-points of silver, copper, and cast iron). In no case could steel or nickel be melted in the top flues.

Details of 4 A.

Average Percentage Rate of Distillation per Second.	Time of Observation (Seconds).	Percentage of Total Gas Evolved in Time Interval.	Total Gas Evolved.	Retort Temperature. Deg. Fahr.			Flue Temperature. Deg. Fahr.		Candle Power per 5 Cubic Feet.
				1	2	3	Top.	Bottom.	
·27	25	6·82	..	..	..	..	..	..	..
·25	55	6·71	13·53	900	977	..	..	..	25·91
·25	85	7·30	20·83	950	1040	..	..	..	20·01
·29	115	13·03	33·86	990	1173	..	..	..	18·22
·30	145	9·98	43·84	1020	..	..	..	..	17·84
·31	175	10·98	54·82	1030	1339	..	..	..	16·00
·32	205	10·37	65·19	1130	1589	977	+1929	−1749	13·74
·32	235	9·87	75·06	1260	..	1040	..	..	12·20
·32	265	8·87	83·93	1440	..	1173	..	..	10·46
·31	295	7·76	91·69	1620	..	1339	..	..	8·82
·29	325	5·27	96·96	..	..	..	..	..	6·90
·28	355	2·49	99·45	..	..	..	..	..	..
·27	366	0·55	100·00	..	..	..	..	..	..
..	Hours. 6·1	100·00	..	..	..	..	..	..	..

Details of 2 A.

·39	15	5·86	5·86	900	..	..	..	..	..
·39	45	11·87	17·73	1000	1040	1040	..	..	..
·37	75	10·27	28·00	1260	..	..	..	..	21·80
·37	105	11·30	39·30	1280	..	..	..	..	16·90
·37	135	11·30	50·60	1290	1173	1173	..	..	14·80
·38	165	11·30	61·90	1300	1339	1339	+1929	+1749	13·40
·37	195	9·65	71·55	1295	..	1429	..	..	11·20
·36	225	9·65	81·20	1295	1589	..	..	..	..
·35	255	7·70	88·90	1305	..	..	..	..	..
·33	285	4·17	93·07	1340	..	..	..	..	..
·31	315	4·18	97·25	..	..	..	..	..	..
·29	345	2·57	99·82	..	..	..	..	..	..
·28	360	0·18	100·00	..	..	..	..	..	..
..	Hours. 6	100·00	..	..	..	..	..	..	..

Details of 3 A.

·35	40	14·1	14·1	1290	..	..	..	..	24·30
·37	70	12·1	26·2	1320	1040	..	..	..	19·70
·38	100	11·6	37·8	1340	..	1040	..	..	..
·41	130	15·6	53·4	1350	..	..	..	..	..
·40	160	10·7	64·1	1370	..	..	..	..	17·20
·38	190	9·1	73·2	1370	1173	..	+1929	+1749	..
·38	220	9·1	82·3	1450	1339	1173	..	..	14·20
·35	250	5·5	87·8	1520	..	..	..	..	..
·33	280	4 0	91·8	1600	..	1339	..	..	..
·31	310	3·7	95·5	..	1589	1589	..	..	..
·28	340	3·1	98·6	..	..	..	..	..	..
·28	360	1·4	100·0	..	..	..	..	..	..
..	Hours. 6	100·0	..	..	..	..	..	..	..

Details of 5 A.

..	10	..	..	1000	977	977	..	..	..
·70	40	28·2	28·2	1000	..	..	..	..	..
·57	70	11·7	39·9	1050	..	..	..	..	..
..	100	..	..	1080	1040	..	..	..	16·46
·51	130	26·1	66·0	1270	1173	1040	+2100	+1749	14·20
..	160	..	..	1330	1339	1173	..	..	12·90
·41	190	11·8	77·8	1560	1429	1339	..	..	..
..	220	..	..	..	1589	1429	..	..	..
·37	250	14·0	91·8	1600	..	1589	..	..	..
·34	280	4·3	96·1	1730	..	..	..	..	..
·32	310	3·0	99·1	..	..	..	..	..	..
·31	324	0·9	100·0	..	..	..	..	..	..
..	Hours. 5$\frac{24}{60}$	100·0	..	..	..	..	..	..	..

Details of 6 A.

·27	35	9·3	..	..	1000	1200	..	..	25·70
·36	65	14·3	23·6	..	1180	1450	..	..	21·40
·38	95	12·4	36·0	977	1210	1525	..	..	19·10
·38	125	11·0	47·0	..	1220	1585	..	..	17·00
·38	155	11·5	58·5	1040	1230	1655	+2100	+1749	15·40
·38	185	11·3	69·8	1173	1280	1740	..	..	14·30
·37	215	9·5	79·3	..	1430	..	..	..	11·70
..	245	..	..	..	..	..	..	..	4·50
·34	275	15·1	94·4	1339	..	..	..	..	4·50
·32	305	4·1	98·5	..	..	..	..	..	..
·31	320	1·5	100·0	..	..	..	..	..	..
..	Hours. 5$\frac{20}{60}$	100·0	..	..	..	..	..	..	..

Details of 1 A.

·44	25	10·9	..	..	..	..	..	..	..
·44	55	13·1	24·0	..	977	..	..	..	20·50
·44	85	13·7	37·7	..	1040	977	..	..	16·00
·45	115	13·7	51·4	977	1173	..	..	..	15·50
·45	145	13·3	64·7	1040	1339	1040	..	..	14·00
·43	175	11·4	76·8	..	1429	1173	..	..	11·80
·42	205	9·6	85·7	1173	1589	1339	+2100	+1749	7·90
·39	235	6·3	92·0	..	..	1589	..	..	7·90
·37	265	5·0	97·0	1339	..	..	..	..	7·80
·34	295	2·1	99·1	1589	..	..	..	..	8·00
·32	310	·9	100·0	..	..	..	..	..	..
..	Hours. 5$\frac{10}{60}$	100·0	..	..	..	..	..	..	..

Series K.

Number of Trial.	Tons of Coal Carbonized per 1000 Square Feet of Retort Surface per 24 Hours.	Maximum Observed Gas Production per Square Foot of Retort Surface per 24 Hours.	Average Gas Production per Square Foot of Retort Surface per 24 Hours.	Cubic Feet of Gas per Ton of Coal.	Temperature of Top Flue. Deg. Fahr.	Temperature of Bottom Flue. Deg. Fahr.	Proportion per Cent. of Total Gas Evolved Below a Certain Retort Temperature.
2	5·4	77	48	8,864	..	1480–1580	99·1 below 1320
3	5·8	69	49	8,429	..	1490–1540	97·9 „ 1340
8	5·9	127	55	9,378	..	1600–1680	All „ 1340
7	6·7	93	65	9,799	..	..	..
1	6·9	83	59	8,611	..	1400–1580	99·0 below 1300
4	7·1	97	64	9,077	..	..	..
6	7·1	107	68	9,534	..	1550–1650	98·0 below 1340
9	7·1	99	70	9,872	..	..	..
13	9·8	226	113	11,528	..	..	..
11	10·3	163	116	11,253	..	..	..
14	10·3	185	118	11,413	+2100	+1749	..
12	10·3	194	125	12,102	..	..	..
10	10·3	187	126	12,190	..	..	..
15	11·4	247	134	11,792	+2100	+1749	..
18	12·3	230	143	11,628	..	..	..
16	12·4	209	143	11,508	..	..	..
19	13·0	235	141	10,865	..	..	30 at 977
17	14·7	272	166	11,331	+2100	+1749	66 below 1359

DETAILS OF 1 K.

Time in Seconds.	Percentage of Gas Evolved in Time Interval.	Total Gas Evolved.	Retort Temperature (Average of Two Retorts).	Temperature of Top Flue. Deg. Fahr.	Temperature of Bottom Flue. Deg. Fahr.	Candle Power per 5 Cubic Feet.
..	..	..	..	..	1510	..
70	14·8	14·8	980	+1749	1480	24·35
130	15·1	29·9	1160	..	1540	..
190	17·0	46·9	1220	..	..	..
250	17·1	64·0	1240	..	1400	17·70
310	15·1	79·1	1190	..	1400	14·60
370	10·7	89·8	1200	..	1480	13·50
430	7·0	96·8	1300	..	1500	10·10
490	3·1	99·9	1300	..	1530	11·30
505	0·9	100·0	1395	..	1580	..
Hours. 8⅓	100·0	..	..	..	..	..

DETAILS OF 3 K.

Time in Seconds.	Percentage of Total Gas Evolved in Time Interval.	Total Gas Evolved.	Temperature of Retort. Deg. Fahr.	Temperature of Side Flue. Deg. Fahr.	Candle Power per 5 Cubic Feet.
37	8·1	..	960	1490	..
97	14·8	22·9	1020	1480	..
157	15·1	38·0	1050	1500	20·4
217	15·1	53·1	1050	1500	17·1
277	13·6	66·7	1040	1520	16·0
337	11·9	78 6	1040	1540	15·8
397	9·8	88·4	1120	1540	12·7
457	6·0	94·4	1260	..	11·4
517	3·5	97·9	1320	..	11·0
577	1·7	99·6	1370	..	10·5
592	0·4	100·0	1400	..	..
..	100·0	..	..	..	..

SERIES B.

Cubic Feet of Gas per Ton of Coal (corrected).	Tons of Coal Carbonized per 1000 Square Feet of Retort Surface per 24 Hours.	Maximum Observed Evolution of Gas per Square Foot of Retort per 24 Hours.	Average Evolution of Gas during the Charge per Square Foot of Retort Surface per 24 Hours.	Candle Power of Whole Bulk per 5 Cubic Feet. (Averages of Three Tests.)
11,582	12·7	189	147	16·17
12,528	13·2	243	165	16·40
11,878	13·3	208	158	16·60
11,007	13·7	192	150	16·67
11,565	13·7	225	158	15·96
11,756	13·7	232	160	16·60
11,757	13·8	221	162	16·42
11,480	13·9	187	160	16·50
11,715	14·2	215	166	16·60
12,171	14·2	231	172	16·40
11,706	14·7	243	172	16·50
11,713	15·0	284	175	16·60

TABLE C.

[TEMPERATURE AVERAGE. Retorts carbonizing 11·8 tons of Coal per 1000 Feet super. of retort surface per 24 hours.]

Time of Observation (Seconds).	Percentage of Total Gas Evolved.	Average Retort Temperature. Deg. Fahr.	Candle Power per 5 Cubic Feet.
30	12·3	1108	21·8
60	26·1	1212	20·2
90	38·9	1260	17·7
120	52·6	1292	14·8
150	65·8	1315	13·5
180	78·6	1360	11·7
210	86·5	1435	10·7
240	92·6	1531	7·1
270	96·4	1613	5·1
300	100·0	1671	3·8

Mr. E. W. Scott, Assistant Inspector of the London County Council, has been appointed Chief Inspector at the Westminster gas-meter testing-station, in place of Mr. C. E. Mills, who left his duties about the end of March, and disappeared.

The Hybrid Committee on the London Water Bills have chosen Mr. Plunket as their Chairman. They will sit from Tuesday to Thursday each week (commencing to-day), until their labours are completed. The constitution of the Committee was given in our "Parliamentary Intelligence" last Tuesday; but it has since been announced that the name of Mr. C. H. Wilson (Hull) should be substituted for that of Mr. A. Billson.

Acetylene Gas for Public Illumination.—It is interesting to record that, on the occasion of the visit of the Duke and Duchess of York to Sheffield last week, acetylene gas was employed with remarkable effect in the illumination of the premises of Messrs. S. H. Ward and Co., of the Sheaf Brewery. The gas was produced from temporary plant put up expressly for the purpose; and it was consumed in 100 burners (ooooo size). The result was the production of probably the most brilliant light ever seen in this country from gas. This is the first attempt in England at public illumination with acetylene gas.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1031.)

THE brilliant weather (always favourable to the railway market) seemed last week to spread its genial influence over every department of the Stock Exchange. Business went on merrily; there was any quantity of money; and people were enthusiastic, and ready to give better prices for everything. On Wednesday, Consols were actually done at 106½—a record price. The recovery in the United States is progressing happily; and the Foreign Market was much cheered by the apparent settlement of peace conditions in the East. The only quarter in which prices showed a falling off was the Mining Market, where the enormous speculation is beginning to make some people apprehensive that it may have been a little overdone. And this affects the Money Market, where there is a disposition growing to be cautious in the lending of money for settlement. The Gas Market was certainly quieter last week; but though the volume of transactions was lighter, there was no diminution in its strength. Prices did not boom as they did in some other departments, as there was scarcely room for that. But a few significant advances in value were effected; and no quotation fell away. In Gaslights, the "A" was moderately dealt in every day at slightly improving figures, opening at 269, and closing at 270½. The secured issues showed a little increase in activity; and prices at or near the top figures were readily obtained, though the quotations were still left unchanged. Business in South Metropolitans was well up to the mark, and at good steady figures; while the "C" made a small improvement. Nothing at all was recorded in Commercials. The Suburban and Provincial Companies made further advances in their steady upward march—British and Alliance and Dublin being the gainers of half a point each. Continental undertakings were very firm, though not particularly active; and Imperial came out one better on *ex div.* correction. The few transactions marked in those located in the remoter world showed general firmness; and Bombay is better by the value of the dividend. The fall in Water quotations still proceeds. Five of the Companies show further retrogression; but East London gave some promise of a slight recovery.

The daily operations were: The Gas Market was rather quiet on the opening day; and prices were strong and steady without moving. Water also was unchanged. Business continued about the same on Tuesday; and Gas quotations held on unchanged. In Water, New River fell 5; Southwark ordinary, 2; and Grand Junction and Lambeth, 1 each. Wednesday was another quiet day; and Gas and Water quotations remained unmoved. Inactivity continued on Thursday; but each issue of Alliance and Dublin advanced ½. On Friday there was more movement in Gas. Imperial Continental improved 1; British, ½; and each Bombay issue, ¼. Lambeth Water fell 2. Good prices for Gas ruled on Saturday; and South Metropolitan "C" rose 2. Chelsea Water was 2 lower.

BOYLE AND HUMPHREYS-DAVIES ON RATING.*

IT is commonly understood that the appearance of the second edition of a book amounts to a sort of certificate of its usefulness or interest, according as it is a book for work or play, dealing with matters of fact or of the imagination. We should have some hesitation in declaring off-hand to which of the two latter categories a book on rating belongs. But in any case, the subject is serious enough for those who are called upon to deal with it; and the help of a good book is indispensable to this end. That such a description applies to the work now under notice is, as we have already observed, guaranteed in the most practical method known to the book trade. Apart from this, it is necessary that a book having pretensions to be esteemed a standard authority upon such a subject as the law and practice of rating, should be revised and brought up to date from time to time; and this is the first that has come under our notice to which the process has been applied since the last quinquennial assessment of the Metropolitan gas undertakings. At the commencement of noticing the present work, we regret to have to draw attention to a weakness on the part of the authors, which is unhappily too often met with in writers on technical subjects. It is the imperfect English and clumsy diction by which the authors have marred their very first page, and thereby raised a presumption against their intelligibility in the possible event of their setting themselves further on to explain obscure points of law or practice. The authors' opening sentence reads as follows: "Probably there is no portion of the laws upon which our social institutions are founded in which an English citizen

* "The Principles of Rating, Practically Considered, as they affect the Assessment of Railways, Docks, Tramways, Gas and Water Works, Coal and other Mines, Electric Lighting Works, Manufactories, and other Hereditaments, with a Complete Digest of all the Important Cases," &c. By Edward Boyle, Barrister-at-Law, and G. Humphreys-Davies, a Fellow of the Surveyors' Institution. Second Edition. London: William Clowes and Sons, Limited; 1895.

has more direct and personal interest than that which regulates the incidence of the burden of local taxation; and yet it is hardly too much to say there is no other branch of law of which the average Englishman exhibits less knowledge and even apparent indifference." The writers evidently meant to insert the word "more" before the penultimate word of this sentence, but forgot to do so, with the result of giving the reader an unpleasant shock. We do not wish to make too much of this fault; but it is really far from being a light one, especially in a legal author. Whatever else may be required for an understanding of the law of the land—of which no man dare be ignorant save at his own peril—clear English is the first essential in those who essay to teach it.

To proceed to the subject-matter of the work. The authors start their explanation of the English poor-law system with a reference to its origin in the celebrated statute enacted in the reign of Elizabeth, by which the overseers of every parish were directed "to raise weekly, or otherwise, by taxation of every inhabitant, parson, vicar, and other, and of every occupier of lands, houses, tithes, impropriate or propriations of tithes, coal mines or saleable underwoods in the said parish, in such competent sum and sums of money as they shall think fit, a convenient stock of flax, hemp, wool, thread, iron, and other ware and stuff to set the poor in work, and also competent sums of money for and towards the necessary relief of the lame, impotent, old, blind, and such other among them being poor and not able to work, and also for the putting out of such children to be apprentices to be gathered out of the same parish." When one reads such words, it is difficult to resist the impression which they conveyed to the mind of Prince Bismarck, that here we have positively socialistic legislation put upon the statute-book at a period when no such ideas as that now conveyed by the term socialism had entered the heads of statesmen. One can hardly bring himself to believe that such a law would be passed to-day in any European country.

However, there the law is; and its main principle is still operative, although the novel circumstances created by the introduction of railways, docks, and gas-works—to say nothing of other new descriptions of hereditaments—have rendered its application to all cases a work of enormous difficulty, giving rise to innumerable disputes. Hence the mass of "cases" by which the law of rating has been at the same time expounded and made a more laborious study. The authors proceed to define poor-rate as a personal tax in respect of an occupation of land, such occupation being beneficial—that is to say, capable of yielding a profit over and above the average annual cost of keeping it up. They then go on to show how this condition applies in a variety of instances. The first mention of gas and water supply occurs in the course of a discussion of the difference between an actual occupation of land, which creates liability to the rate, and an easement, which is not rateable. Gas and water companies, as they well know, are held to be in effective occupation of the land in which their pipes lie. The "competition of the hypothetical tenant" has a chapter to itself, in which the characteristics of this creature of the imagination are set forth and discussed at length, but not superfluously, having regard to the extreme importance of the conception. The question of the rating of machinery is duly considered; the nature of statutable deductions is expounded; and the rating of gas-works is discussed with some fulness, although no recent case is quoted. It would have rendered the book more valuable if the last Gaslight and Coke Company's cases had been noticed, if only for the sake of the remarkable form in which the decision of the Court was given. On the whole, we are able to recommend this work for a place upon the bookshelves of the consulting gas engineer, as well as in the professional library of the assessment surveyor.

The Late Mr. T. Hardick.—The funeral of the late Mr. Thomas Hardick, whose death on the 6th inst. was announced in the JOURNAL last week, took place on Thursday, at the Baptist Chapel, Warminster.

The Amsterdam Exhibition.—This exhibition, which has already been mentioned in our columns, was opened last Saturday, in the absence of the two Queens, by Baron van Bellinchave, the Grand Master of Ceremonies, who was received in the rotunda of the main building by M. Meinesz, the Burgomaster of Amsterdam, by M. Calisch and M. van Mesdag, the President and Vice-President of the Executive Committee, and by the leading officials of the exhibition. The ceremony was attended by a large assemblage of military officers and civilians, as well as by several members of the Cabinet. A dinner was given in the evening, in the Palais de l'Industrie, to celebrate the event. The exhibition, which was originally planned as one of hotel equipment and travel, but was subsequently enlarged to the scope of an International Exhibition, is the first of its kind held in Amsterdam since that of 1883. It occupies the same site—the buildings and grounds covering an area of more than 160,000 square metres. It comprises exhibits connected with the building and furnishing of hotels and *cafés;* the construction and equipment of railways and ships; the latest electric inventions; and various industries. One of the attractions is a reproduction of Old Holland. The grounds have been tastefully laid out with shrubberies and flower-beds.

NOTES.

Uniformity in Testing Structural Materials.

The American Society of Civil Engineers have had a Committee to inquire into methods of testing structural materials, with a view to drafting a uniform system of testing and standard of quality, for the guidance of members of the profession when drawing up specifications. The Committee recently reported that, having fully considered the matter, they have concluded that standard specifications for uniform methods of testing materials used in metallic structures should be of such general character as will meet the requirements of usual conditions, so that their adoption may conduce to the observance of a more nearly uniform practice in shops and mills, while at the same time leaving the engineer free to meet the special needs of any unusual conditions by supplementary or other specifications. With regard to cast iron, it is remarked that the infrequent use of this material justifies only the most simple and convenient tests. Hence the Committee recommend the transverse test of a specimen bar of 2 inch by 1 inch cross section and 27 inches long, resting flatwise on dull knife-edges 24 inches apart, by a load of 2000 lbs. in the middle. The specimen is to carry at least this load for not less than two minutes, with a deflection of 0·3 inch. The fracture must present the appearance of grey iron of good quality. As to wrought iron, it is recommended that all bars, plates, and other structural members shall bear a tensile strain of 26,000 lbs. per square inch before yielding, and break at from 46,000 lbs. for plates to 50,000 lbs. for bars. The elongation should range from 8 per cent. in plates to 20 per cent. in bars; and the reduction of area, from 12 to 30 per cent. in the same cases respectively. Specimens should bend cold 90° without fracture, with an inner radius not exceeding double the thickness of the piece for bars, nor three times the thickness for plates. Rivet iron must be soft and tough, and must bend cold until the sides are in full contact. The methods of testing wrought iron may be applied to rolled steel, with the addition of the quenching test, by which a specimen heated to cherry red is quenched in water of 82° Fahr., and then tested as usual. The drifting test is not recommended. For rolled steel, it is advised that a mean ultimate resistance be specified for every grade required; and that a variation more than 4000 lbs. any way should not be tolerated. It is also recommended that the yield-point, the elongation, and the reduction of area should be functions of the ultimate strength, which should range from 60,000 lbs. for low-grade, to 70,000 lbs. for high-grade steel, with a yield-point of 55 per cent. Rivet steel, when heated to a low cherry red, and quenched in water at 82° Fahr., must bend to close contact. The full report of the Committee is published in the January number of the Transactions of the Society.

The Hermite System of Sewage Treatment.

In a report upon the Hermite system of sewage treatment by electrolyzed sea water, as tried at Worthing (see JOURNAL for Sept. 11 last, p. 526), Sir Henry Roscoe and Dr. Joseph Lunt inform the British Institute of Preventive Medicine that the process in question proposes to effect a complete disinfection and sterilization of the entire sewage of towns by the application of an electrolytically formed disinfectant, which is intended to be used for flushing purposes. In this respect it differs essentially from the Webster sewage purification process, in which it is the sewage itself that is electrolyzed. If there were anything in the Hermite process, it might be employed as a device for providing a "day load" for electric lighting plant at seaside stations. It appears from the report that the effect of electrolyzing sea water in the Hermite way is to produce a fluid containing a soluble hypochlorite which remains in solution. The solution is extremely unstable, and is useless as a disinfectant when 24 hours old. As the result of many experiments, the report states, among other things, that electrolyzed sea water of the strength which M. Hermite proposed to employ is only effective when used within half an hour after being prepared. Within these limits, the fluid acts as an excellent deodorizer, but is not a disinfectant even when used of greater strength. According to Dr. W. S. Squire, the process is only a very cumbrous and expensive way of making chlorine, seeing that there is no claim that the Hermite fluid will do more than a solution of bleaching powder would accomplish. Thus it appears that the hopes of the electrician in the matter of getting a bye-product are blighted once more.

Antimonial Glazing of Cooking-Pots.

The attention of purchasers of enamelled gas cooking-stoves and culinary appliances should be directed to a report by Herr Paul Kaszper, in *Dingler's Polytechnisches Journal*, upon the use for this purpose of glazes with antimony as a constituent. It is remarked that for some time past iron cooking utensils with an enamel glazing of special brilliancy have been in the market. The author has investigated the composition of this enamel, and also the action of vinegar upon it. The analysis gave the following results: SiO_2, 39·80; Al_2O_3, 10·04; SnO_2, 1·19; Sb_2O_3, 14·32; P_2O_5, 2·73; CaO, 0·36; K_2O, 7·72; Na_2O, 8·92; B_2O_3 (by difference), 14·92—total, 100·00. On boiling 8·9041 grammes of the enamel in small pieces with 250 cubic centimetres of strong vinegar, 1·61 per cent. was dissolved; and on adding HCl and H_2S to the solution, an unmistakable precipitate

of sulphide of antimony was obtained. For the purpose of comparison, 400 cubic centimetres of the same vinegar were boiled in two new pots of equal size, one of which was glazed with the ordinary tin oxide enamel, and the other with the antimony enamel. In the case of the former, 0·3147 gramme was dissolved; with the latter, 0·5036 gramme. The greater amount of corrosion in the antimony-glazed pot was also perceptible; and, as in the first experiment, the antimony dissolved could be readily precipitated as sulphide. These results, which are given in English in the current number of the *Journal of the Society of Chemical Industry*, show that the presence of such a large portion of antimony in enamel glazing demands serious attention in the interests of public hygiene.

TECHNICAL RECORD.

STREET SUBWAYS FOR LARGE TOWNS.

At the Meeting of the Society of Engineers on Monday last week, Mr. CHARLES MASON, Assoc.M.Inst.C.E., the Surveyor to the Vestry of St. Martin's-in-the-Fields, read a paper on the above subject, which was briefly noticed in the JOURNAL on the following day.

The author began by stating that, though many reports had been prepared by municipal engineers, and much evidence given, the subject of subway construction was still one requiring the serious consideration of the engineers to public authorities and gas, water, electric lighting, and other companies. He went on to remark that the old-fashioned method of laying underground pipes is such that a periodical inspection of the various mains, for ascertaining their condition or for stopping leakages, is almost impossible. Especially is this the case with gas and electric mains; and the recent explosions in several parts of the Metropolis have imposed a duty upon those having the control of the streets to devise some better system, whereby material, of whatever nature, laid underground can be easily examined from time to time. The construction of subways is, in his view, the most satisfactory, and in fact the only, method for laying pipes and mains so that these conditions can be complied with.

Dealing with the existing arrangements, the author expressed the opinion that nothing could be more unsatisfactory; but he admitted that the remedy was attended with many difficulties unknown to the ordinary observer. It is now almost an axiom in building that "no pipe must be out of sight;" and anyone erecting a house and burying the supply or waste pipes in brickwork or plaster, or by other means making them inaccessible, is looked upon somewhat as a "jerry builder." The same law should, he thinks, apply to the streets; for what is lost to the householder in case of a desired examination for an escape, is also lost to the ratepayers in examining an underground main. Undetected leakages may also, and often do, exist for long periods. Someone consequently suffers thereby—as, for example, the householder, in the case of a leakage from the water-main percolating into his basement; the water company, from loss of water; the gas company, who lose gas; and the public generally, from risks incurred in using the streets.

The author went on to show that there is no recognized system of laying pipes. He remarked that, by the present system, pipes are laid on the "first come, first served" principle. Plans are submitted to the local authorities, showing the proposed route, and duly approved. When the ground is opened, however, it is often found that other pipes are in the way; consequently detours have to be made. The author has known instances in a street containing many pipes where mains have to be "looped" from point to point. Dead or disused pipes also exist in the streets in numerous cases. These should be taken out, as they become as much a block underground as the live pipes; and moreover they serve as conductors for gas in case of leakages.

Interesting statistics were given, showing the enormous annual cost of opening up the pavements for examination of, and repairs to, mains; and the various powers conferred by Acts of Parliament upon local authorities, and the bye-laws made thereunder, together with the objections on the part of the owners of the mains to using the subways, were fully explained. The author stated that, where subways do not exist, municipalities lose to a certain extent the control of the streets; and he expressed the opinion that, if the several companies were under one control, the local authorities would be in a better position to cope with the difficulties they now experience.

Early subways were next described. The first subways to be constructed in London were those in Southwark Street and Garrick Street, which were made about the year 1862. The first provincial town to adopt the principle was Nottingham—a subway having been constructed there in 1863, from the designs of the late Mr. M. O. Tarbotton. The author stated that the granite pavement in this street was not interfered with in any way for the first 25 years of the subway's existence; and he thought this fact spoke for itself as to the value of an underground construction. Subways have been made in connection with most of the Metropolitan improvements, as in the case of the Holborn Viaduct, the Thames Embankment, the Charing Cross Road, &c.; and the principle is now being generally adopted by the London County Council in all their street improvements. The London subways are, however, in the author's opinion, too small, and should be made to embrace the greater part of the width of the street. The subways constructed at Nottingham in 1887, when the author was Assistant-Engineer to the Corporation, are similar, in general arrangement, to those in the Metropolis; but they vary in size, and have more laterals or side-ways. In this case, moreover, vaults were constructed beneath the footway; and, being the property of the Corporation, they were leased to adjoining owners—thus bringing in some return on the outlay.

The subways adopted in the Metropolis, as well as those at Nottingham, though a step in the right direction, do not, in the author's opinion, meet the case as fully as is necessary. Considerable difficulty is experienced by the several companies possessing pipes therein in connecting from the subway to the premises to be supplied; and it is found that this construction, while minimizing to a very great extent the breaking up of the street surfaces, does not, especially in London, entirely obviate it. The author is fully alive to the difficulties of designing a subway that shall be satisfactory to all parties concerned; and he is of opinion that most of the subways already constructed are open to several objections. The main points for consideration in designing a subway are: (1) The number and size of mains likely to be laid therein (present and future); (2) ample space for workmen; (3) pipes to be so placed as to allow facilities for repairs, connections, &c.; (4) provision for sewer inspection and ventilation; (5) light and ventilation to the subway; (6) service-pipes not to cross the subway; (7) gas and water pipes to be laid with a fall; (8) overhead construction to be water-tight; (9) provision for street gulleys, lamps, fire-hydrants, and water-posts. To meet these requirements, the author has designed a subway which he described. It is on the "triple" system, with a central avenue for trunk mains, and side avenues for subsidiary mains or service-pipes; vaults being provided beneath the footways, remaining the property of the public authority, and leased to the adjoining owner.

A detailed description of the method of construction was given, with an estimate of the cost, showing a profit based mainly upon returns of the rentals derived from the vault construction and charges for those using the subway. The saving which would accrue in keeping the streets free from obstruction could not, the author stated, be reduced to figures on the credit side, though the saving to life and rolling stock would be very great. Immunity from frozen pipes, due to a uniform temperature in the subways, was instanced as an argument in favour of their construction.

The author, in conclusion, strongly urged the desirability of obtaining powers whereby the whole of the subsoil of the streets should remain the property of the local authority; and, though not directly advocating the municipalization of all gas, water, and other undertakings, he expressed the opinion that such a course, from a municipal point of view, would cause far less inconvenience than now arises to the public using the streets. The subject was one of a very controversial nature; but, in spite of all obstacles, some form of the triple subway should, he thought, be adopted in all large towns.

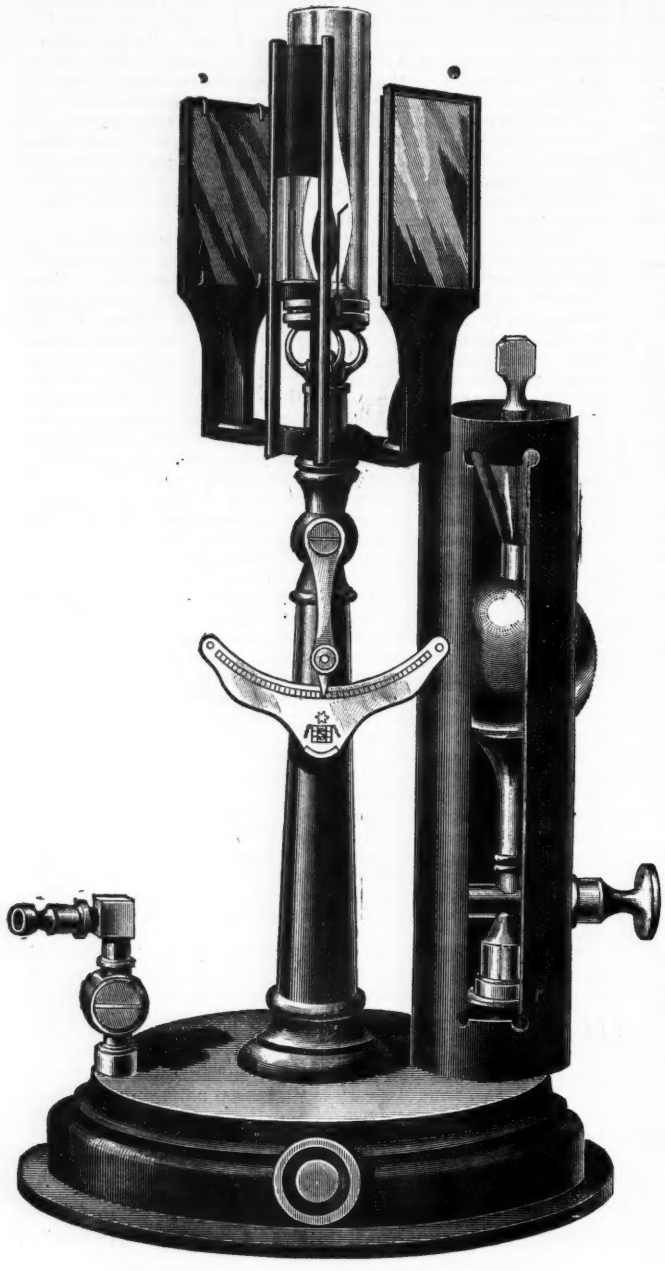
The paper was illustrated by diagrams, which were fully explained by the author.

DIBDIN'S TEN-CANDLE PENTANE ARGAND AIR-GAS STANDARD.

When reading his paper on "The Work of the Photometric Standard Committee," at the meeting of the Incorporated Institution of Gas Engineers last week, Professor Lewes exhibited Mr. Dibdin's 10-candle pentane Argand air-gas standard, which, as will be seen by the paper, given in another part of the JOURNAL, is recommended by the Committee as the standard to be used for testing gas. An illustrated description of the apparatus is given in Section IX. of the appendix to the Committee's report; and this portion of the document we have permission to reproduce.

The apparatus used in producing this standard consists of two separate portions—viz., the burner and the carburettor. The burner is a specially constructed tri-current Argand burner; the annular steatite ring being perforated with 42 holes, each hole being 0·71 millimetre in diameter. The three air currents are: (1) The central current rising inside the steatite to the inner portion of the flame; (2) a current rising outside the steatite, and caused to impinge upon the flame by an inner metal perforated and incurved cone, the top of which is level with the top of the steatite; (3) an outer current rising on the outside of the above cone, and between that cone and the glass chimney. The inner perforated cone is punctured with ten apertures 0·25 inch in diameter, which are provided for the purpose of equalizing the two outer currents of air as may be required to suit the height of the flame.

The glass chimney is carried in the groove provided on the outer cone, which answers the purpose of a gallery; the dimensions of the chimney being 6 inches high and 1¼ inches inside



DIBDIN'S PENTANE ARGAND AND CARBURETTOR.

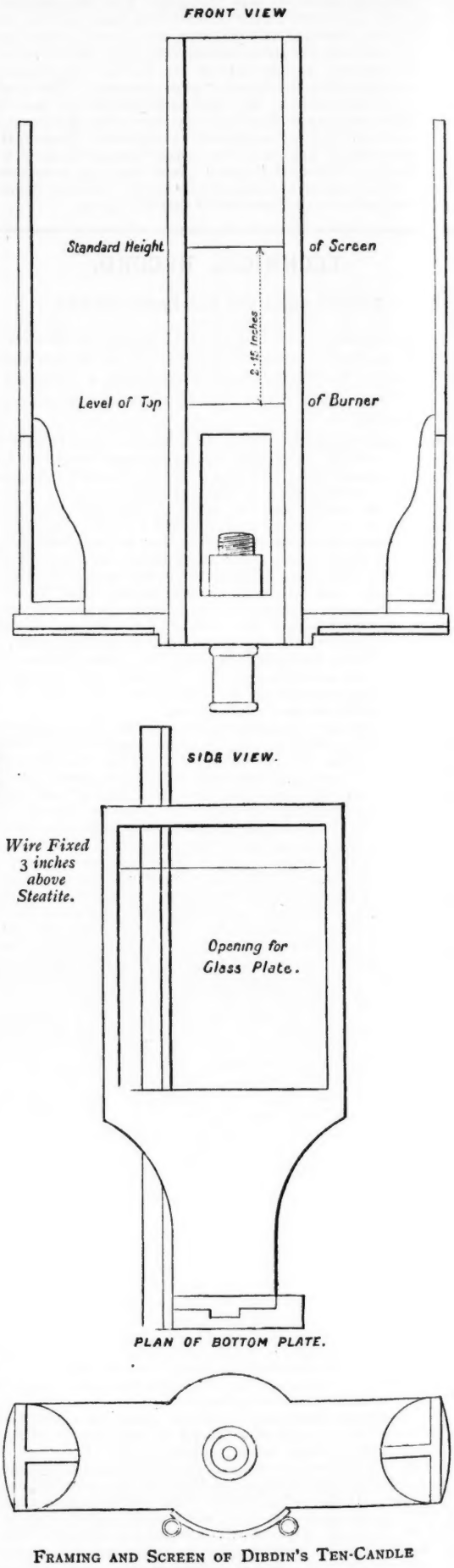
Measurements of Burner.

Number of holes	42		
Diameter of holes	0·71	mm. = 0·028	inches.
Inside diameter of steatite	9·90	,, = 0·390	,,
Outside diameter of steatite	19·05	,, = 0·750	,,
Diameter of inside of metal cone at top	23·62	,, = 0·930	,,
Chimney length	152·40	,, = 6·000	,,
,, inside diameter	38·10	,, = 1·500	,,
Height of cut-off	54·61	,, = 2·150	,,

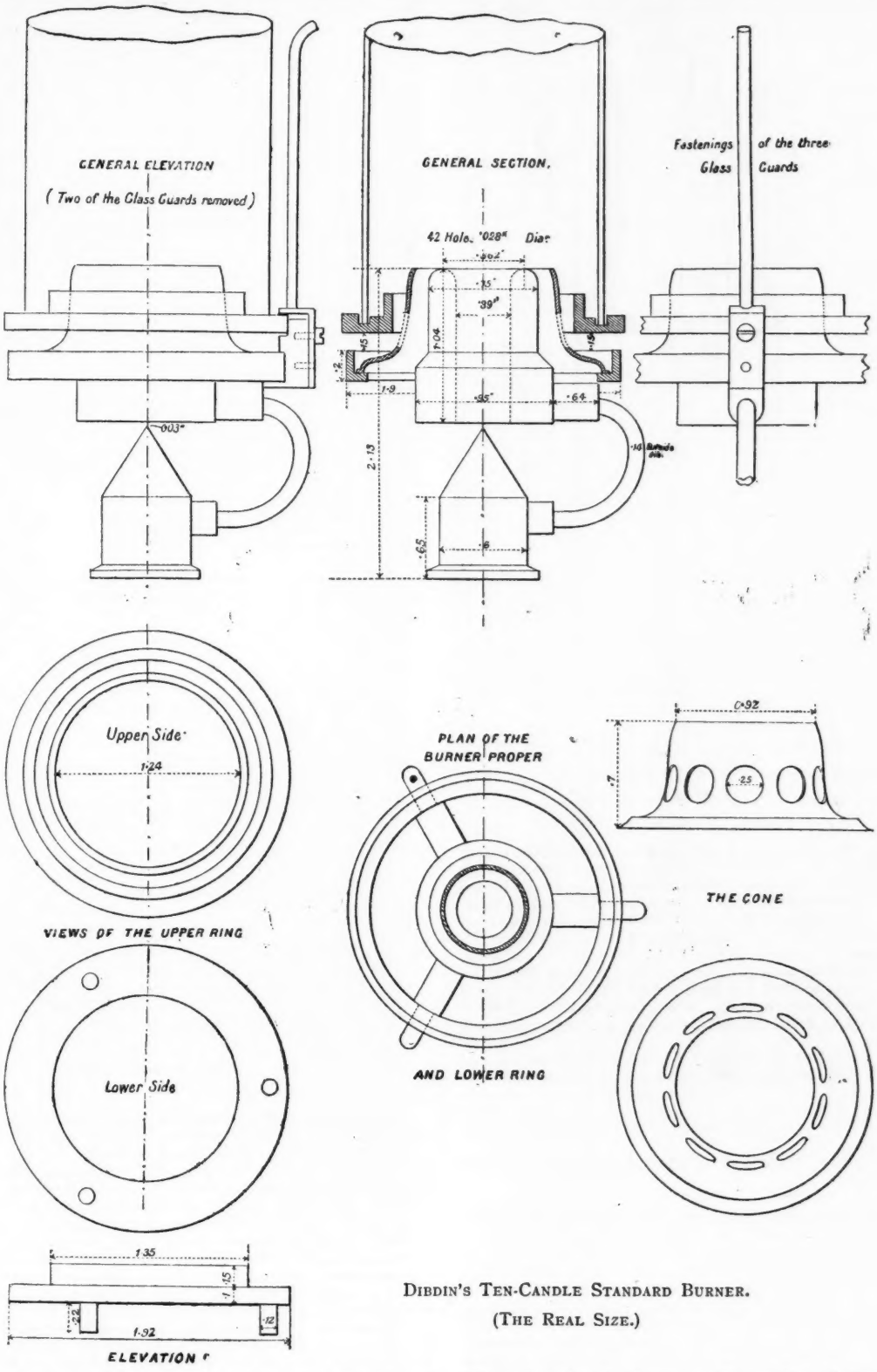
The centre of the flame to be immediately over the terminal of the photometer-bar.

diameter. The top of the flame should be maintained as nearly as possible at 3 inches above the steatite; this point being indicated by the wires crossing the blue glass screens carried on each side of the burner on the metal supports. The flame is steadied by the small air-directing cone situated centrally beneath the steatite; the apex being 0·03 inch below the metal support carrying the steatite.

On the side of the burner to be presented to the photometer disc, a metal screen, 8½ inches in height, is placed and screwed securely to the base-plate. The middle portion of this screen is cut away, so as to leave above the top of the steatite burner an opening 2·15 inches in height and 1·4 inches in width; the lower portion of this opening being exactly level with the top of the steatite. The light emitted horizontally through this opening by the flame produced by the combustion of the gaseous mixture of atmospheric air and pentane formed in the carburettor described below is used as the standard of light. It is equal to the



FRAMING AND SCREEN OF DIBDIN'S TEN-CANDLE STANDARD BURNER.
(ONE-HALF THE REAL SIZE.)



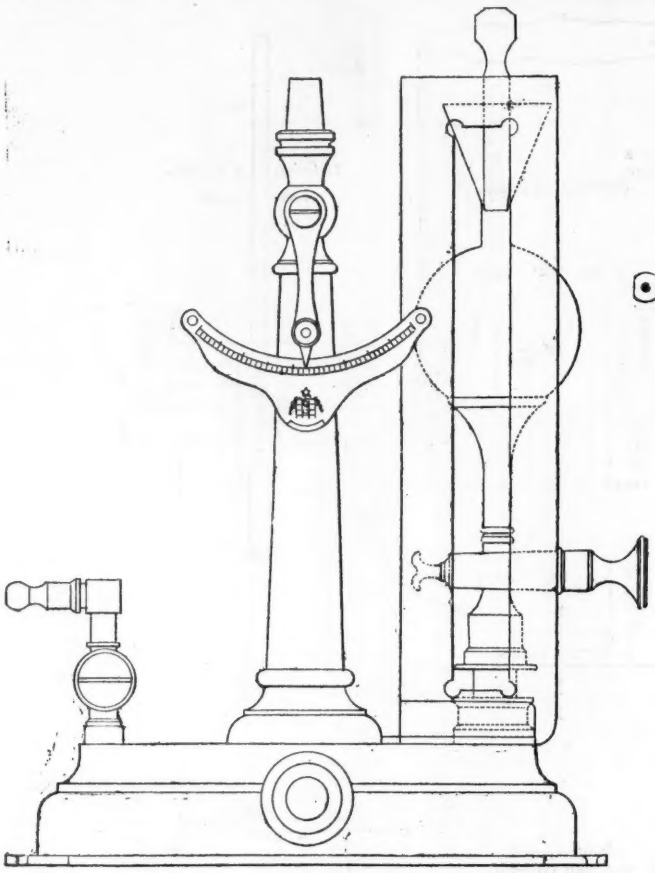
DIBDIN'S TEN-CANDLE STANDARD BURNER.
(THE REAL SIZE.)

light emitted by 10 parliamentary sperm candles. The lower portion of the screen has an opening 1 inch wide by 2·3 inches in height, to allow free access of air to the under portion of the burner.

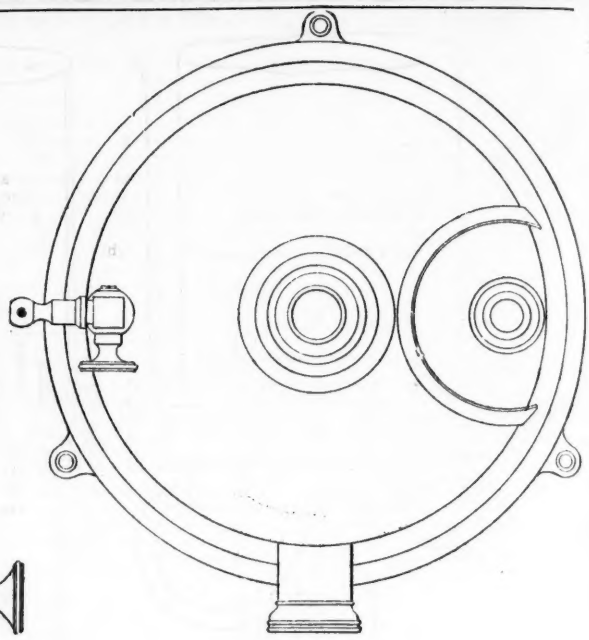
The various dimensions and arrangements of the parts are more particularly described in the following table of measurements and accompanying detailed plans.

The position of the burner in relation to the photometer disc is to be fixed by the burner fitting gas-tight into a faced joint attached to the photometer at the required point; and the burner is to be set at such a height that the centre of the illuminated disc and the bottom edge of the cut-off shall be in the same horizontal plane. The length of the connection between the burner and carburettor may be varied, but should not be more than 5 feet. The centre of the flame is to be immediately over the terminal point of the photometer-bar.

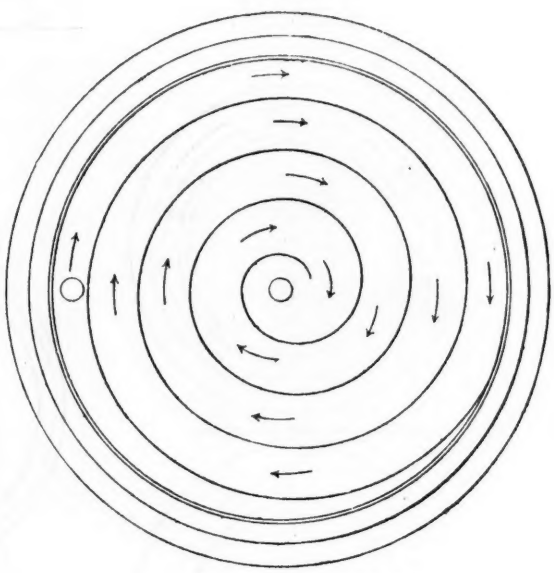
The carburettor for the 10-candle pentane Argand consists of a circular vessel constructed of tinned plate, 203·2 mm. (8 inches) in diameter and 50·8 mm. (2 inches) in depth, having a spiral division 25·4 mm. (1 inch) in width. This division is made by soldering in a spiral strip of metal, 4 ft. 6 in. in length and 2 inches wide, gas-tight, to the under side of the top of the carburettor; so that, when the top is fixed on, the bottom of the strip comes close to the bottom of the vessel, and is sealed by the pentane, so that the air has to pass over pentane for a distance of about 4 ft. 6 in., and becomes thoroughly saturated. At the end of the spiral division, near the side of the carburettor, a bird fountain is fixed for charging the carburettor, and keeping it charged at a constant level with liquid pentane. The lower end of the inlet fountain tube is closed, and rests upon the bottom of the tank. Through the side of the tube, which is 0·4 inch (10·1 mm.) in diameter, 16 holes 1 mm. in diameter are



CARBURETTOR FOR USE WITH DIBDIN'S TEN-CANDLE STANDARD BURNER.
(ONE-THIRD THE REAL SIZE).



PLAN.



PLAN OF SPIRAL CHANNEL

bored close to the bottom, and through these the pentane enters the carburettor. At one side of the inlet-tube, 1 inch from the lower end, a small tube 3 mm. in diameter and 20 mm. in length is connected thereto, and turned upwards. The fountain inlet-tube is carried up through the top of the carburettor, and continued in the form of a bulb having a capacity of about 200 c.c. Stopcocks are provided at the top and bottom of the bulb, for convenience in filling with pentane; and the portion above the upper stopcock is opened out in a funnel shape for the same purpose. When the carburettor is being charged, the gas must be extinguished, to avoid the risk of the vapour firing and causing an explosion.

The inlet for gas or air is at the side of the carburettor, and at one terminal of the spiral division; the outlet being placed in the centre of the vessel, so that the air or gas may travel over the liquid pentane throughout the whole length of the spiral division, and thus become fully charged with the volatile vapour of the pentane.

When using this standard, the pentane must be visible in the fountain bulb.

Sulphate of Ammonia for Mangold Growing.—We learn that some important experiments with sulphate of ammonia as a land dressing—the economy of production being the principal point—are being conducted in Berkshire, Oxfordshire, and Hampshire by the Agricultural Department of the University Extension College of Reading; the tests being gauged by the effects of other artificial and natural manures on the same kind of land and with similar crops. The results of the experiments with mangolds, as carried out in Hampshire, are already to hand. One plot which was not manured at all gave 19 tons 17 cwt. 96 lbs. per acre—a very large yield. A second plot, dressed with 2 cwt. of nitrate of soda, 3 cwt. of superphosphate, 2 cwt. of kainit, and 3 cwt. of salt per acre (costing in all £1 19s.), gave only 13 cwt. more than the unmanured plot. On the third plot, with 2 cwt. of sulphate of ammonia substituted for the 2 cwt. of nitrate of soda (the cost being £2 7s. 6d.), the increase was 1 ton 14 cwt. On a fourth plot, 20 tons of farmyard manure were added to a similar dressing as on the second plot (the cost being £6 9s. per acre); and the increase over the unmanured plot was 8 tons 5 cwt. On plot No. 5, the sulphate of ammonia was again substituted for the nitrate of soda, and 20 tons of farmyard manure added (the cost being £6 17s. 6d. per acre), and the increase over plot No. 4 was 1 ton 2 cwt. It will be seen from these experiments, so far as they have gone, that sulphate of ammonia has proved itself a better nitrogenous manure for mangolds than nitrate of soda.

A Reminiscence of Murdoch.—A sale of great interest to the engineering world will be held on the 21st inst., when Messrs. Fuller, Horsey, Sons, and Cassell will offer, on the premises, the freehold of the Soho Foundry, Smethwick, Birmingham, the once famous works of Messrs. James Watt and Co., formerly Boulton and Watt. It was at the original "Soho Foundry" that James Watt conceived the idea, suggested by a kettle, of utilizing steam for motive power; and the first steam-engine was constructed there. The works, together with the whole of the machinery, tools, &c., are to be offered in the first place as a going concern; and then, if no adequate bid is made, the freehold will be put up separately, and the machinery, &c., sold in various lots. It is satisfactory to know, however, that, while the works may go into other hands, and the engines and tools be dispersed, the historical records of "Old Soho" will be preserved. The "Museum" has been sold privately, as a whole, to a member of the firm of Messrs. Tangyes Limited, whose premises, the Cornwall Works, adjoin the Soho Foundry. This may, no doubt, have caused considerable disappointment to many who would have desired to possess some relics of the historical old firm. But compensation will be afforded by the fact that the collection will, in all probability, through the public spirit of the purchaser, be available to the student and scientific historian. The collection is in itself valuable and interesting. It comprises the whole series of drawings, from the date of the first atmospheric steam-engine, nearly a century and a half ago, to the present time—showing, step by step, the improvements which have been made, and forming, in fact, an almost complete history of the steam-engine. Not less interesting is the collection of letters, including those of Boulton and Watt to each other, correspondence from Murdoch and other "Soho" giants, and from illustrious scientific men.

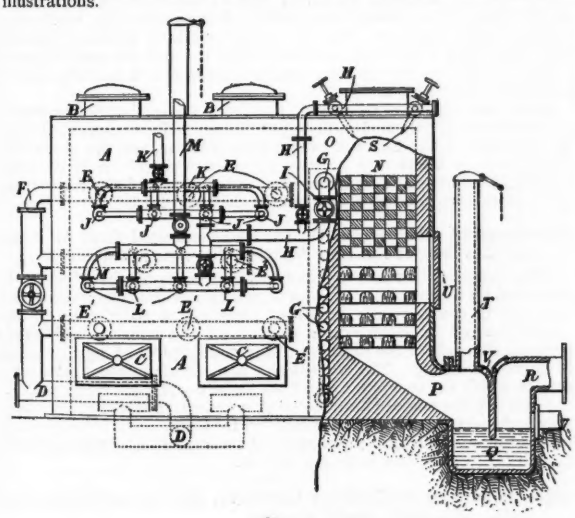
REGISTER OF PATENTS.

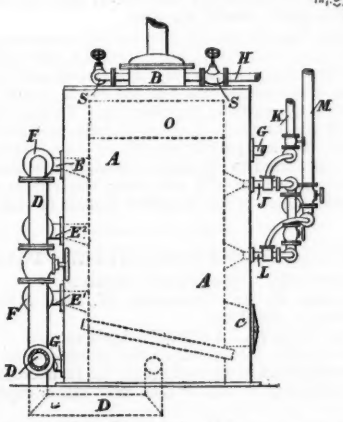
Manufacture or Production of Gas.—Lewes, V. B., of Greenwich. No. 2914; Feb. 9, 1894.

In introducing his specification, the patentee says he has found by experiment that water gas, hydrogen, or mixtures of the two, when carburetted by the vapours obtained by decomposing hydrocarbons, yield a flame which, although it may be of high illuminating value, is far shorter and smaller than the flame obtained from ordinary coal gas; and that, in consequence of this, it has to be burnt in larger quantities in order to obtain a flame which shall, in appearance, equal that of coal gas. He has discovered that this is due to the coal gas containing from 36 to 46 per cent. of methane or light carburetted hydrogen, which gives body and length to the flame, and which only exists in carburetted water gas or hydrogen to the extent of from about 16 to 26 per cent.

The present invention has reference to the manufacture or production of illuminating gas rich in methane, and therefore "more closely resembling coal gas in this respect than the illuminating gas heretofore produced from liquid hydrocarbons." The apparatus employed is of the kind described in patent No. 16,258 of 1892, but is constructed with a second row of injectors arranged at a lower level than the oil-injectors there shown. By means of these lower injectors, tar or heavy hydrocarbon oils can be injected by means of steam, which may be superheated, into the hottest part of a mass of fuel, previously raised to a state of incandescence by blowing air through it, whereby the tar or heavy hydrocarbon oils will be decomposed; carbon being deposited and added to the bulk of the fuel, while large volumes of methane and hydrogen will be generated. When this injection has gone on for sufficient time to partly reduce the temperature of the fuel, there is injected into the fuel by the upper row of injectors lighter hydrocarbons, which, not being decomposed to so great an extent as the others, yield ethylene and other bodies of high illuminating value to the gas obtained. In this way, says the inventor, it is possible to use 3 gallons of tar to 1 gallon of hydrocarbon oil to make illuminating gas of high value.

When tar is used in large quantities for the purpose mentioned, a certain amount of fuliginous matter is carried over with the gas; and where stoppages are likely to be produced from this cause, it is proposed to use a modified construction of apparatus, as shown in the illustrations.





A is a gas-producer, comprising an outer metal casing, lined with fire-brick, and provided with inlets B for fuel and outlets C for clinker. D is a pipe through which air can be blown, from time to time, into the bottom of the producer below the grate-bars, for the purpose of raising the fuel to a state of incandescence. E E^1 are additional air-inlets, arranged at the upper and lower parts of the gas-producer; and E^2 are intermediate air-inlets, each in communication, by a branch-pipe F, with the main air-pipe D, so that several blasts of air can be injected into the fuel simultaneously at different points in its height, for the purposes already mentioned. G is a steam superheating pipe, of serpentine form, embedded in one of the end walls of the producer. One end of this pipe is connected with a steam-generator (not shown), and its other end with a pipe H, provided with a valve I. J are the upper injectors (of which four are shown), through which light hydrocarbon—such as paraffin—supplied by a main oil-pipe K, is blown into the mass of incandescent fuel in the producer by means of the superheated steam. L are lower ejectors (of which five are shown), through which ordinary coal tar or heavy hydrocarbon oil, supplied by a main supply-pipe M, is also blown into the hottest portion of the mass of incandescent fuel in the producer, by means of the superheated steam. N is a regenerator arranged to form part of the same structure as the gas-producer. It is charged with refractory material arranged chequer-wise; the upper portion being composed of fire-brick, while the lower portion consists of small bars of iron. The regenerator is in communication at the top by a passage O with the gas-producer; and at the bottom, by an outlet P and tar-well or vessel Q with a gas-outlet R. The tar-well has a vertical division, the lower end of which is sealed by the tar. S are jets whereby superheated steam can be introduced into the regenerator, for the purpose of assisting the hydrocarbon gas from the producer to flow downward through the regenerator and thence to the gas-outlet. T is the outlet-pipe, in direct communication with P, and through which, upon opening the valve with which it is provided, producer gas is permitted to escape when blowing the gas-generator with air, to raise the fuel to incandescence. U is a door, by removing which access can be gained to the regenerator for cleaning or other purposes; and V are removable covers, to admit of the outlet-pipe being cleared when necessary.

The operation of the apparatus is as follows: Carbonaceous fuel (such as coke) is introduced into the producer, ignited, and then raised to incandescence by air from the blast-main D; the products of combustion thereby produced—and consisting largely of carbon monoxide and nitrogen—being led away through the outlet O down through the regenerator N, and thence through the outlet-pipe T. By this means, the refractory material in the regenerator and the end wall of the producer (containing the steam superheating pipe G) are raised to the required high temperature; and the bars of iron are reduced to metallic iron. The air-blast is then cut off, and ordinary coal tar or heavy hydrocarbon oil is introduced through the lower set of injectors, by means of superheated steam into the lower and hottest part of the mass of incandescent fuel in the producer. There it is decomposed into gas and carbon; the gas, containing large quantities of methane and hydrogen, escaping through the heated regenerator N, and the carbon being added to the fuel in the producer. During this operation, the flow of gas through the regenerator is assisted by jets of steam from the nozzles S, the escaping gas displacing the liquid seal in the left-hand side of the tar-well Q sufficiently to enable it to pass under the division and thence to the outlet R—any matters condensed from the gas falling into the tar-well, from which they ultimately pass away by an overflow. Owing to the great heat of the regenerator, part of the steam admitted is decomposed, and by combining with fuliginous matter carried over with the escaping gas, it forms an additional quantity of gas, and at the same time prevents choking of the regenerator.

After this operation has gone on for a sufficient time to partly reduce the temperature of the fuel, the supply of hydrocarbon and steam to the lower injectors is cut off, and lighter hydrocarbon is injected into the upper portion of the red-hot fuel through the upper injectors J. The ethylene and other bodies of high illuminating value produced escape through the regenerator, tar-well, and outlet-pipe R, and are mixed with the gas containing methane and hydrogen previously produced. This generation of gas is continued until the temperature of the fuel has fallen below the required point. The steam and hydrocarbon are then shut off; and air is turned on so as to again raise the fuel to incandescence. Any hydrocarbon remaining in the gas-producer assists the carbon monoxide generated by the action of the air on the fuel, to reduce to the metallic state any oxide of iron that may have been formed on the bars of iron in the regenerator by the action of the steam admitted, so that the iron will be ready for re-use when again generating illuminating gas.

When working with a gas-producer 12 feet high, 12 feet wide, and 8 feet from front to back internally, the patentee says he has obtained satisfactory results by using 3 gallons of tar to 1 gallon of paraffin; the injection of the former taking about 5 minutes, and the latter about the same time—the steam used being at a pressure of about 100 lbs. to the square inch and heated to a temperature of about 400° C. The relative quantities of steam and hydrocarbon admitted through the injectors into the incandescent fuel should be so regulated that the gas generated is of a brown colour, ascertained as described in the 1892 patent.

Valves for Gas and Chemical Works.—Pye, T. E., and Scull, C. E., of Shrewsbury. No. 9395; May 12, 1894.

This valve for mains in gas or chemical works is designed so as not to be rendered less serviceable by being allowed to remain for a long time in an unaltered position. It consists of a plunger, float, or similar mechanism, by the movement of which a certain quantity of a suitable liquid is displaced, and a small reservoir, in which is contained a quantity of liquid; the movement in one direction and the displacement of the liquid consequent thereon, forming a seal and closing the valve, and the movement in the opposite direction allowing the liquid to flow back and open the valve.

Fig. 1 [next page] shows a longitudinal section of one form of the valve open; also a longitudinal sectional elevation closed, a transverse sectional elevation, and a plan. Fig. 2 shows similar views of another form of the valve, with double plungers; fig. 3, a form of valve with a cupped seating, into which a hollow plunger projects; and fig. 4, a valve with a cupped plunger to be raised to close the valve.

In fig. 1, the valve is constructed with a reciprocating plunger or float B, moving to and fro in the chamber E. The inlet is at one side of this chamber, and the outlet at the other; and the chamber is divided from the inlet and outlet orifices by the diaphragms. Between the plates, a second chamber F is formed, into which the sealing liquid is displaced when the plunger is lowered. Below E and B is a reservoir C, large enough for the plunger to enter. It contains water or other liquid (to form a seal), with which it is filled up to about a level with the aperture in the division-plate. The float or plunger is preferably provided with an annular flange or valve-face, to fit on to a

corresponding seating, as security against any sudden excess of pressure, in which case an annular groove is formed near its lower end to provide the necessary gas-way. The actuating rod or spindle G is surrounded by a sealing-tube H, to contain mercury or other liquid to prevent the escape of gas. By lowering B into the reservoir, the water is displaced, and rises in the chamber E and F to cover the aperture in the division-plate, whether used for the inlet or outlet. It will be raised in the outlet chamber F and depressed in the reservoir C, in inverse proportion to the areas of the two. On raising the plunger or float again, the liquid will flow back into the reservoir, and the gas-way be fully opened. This construction of valve may be used as a drip-syphon or well and valve combined; the condensed liquor running into the reservoir, and being utilized for the purpose of forming the seal.

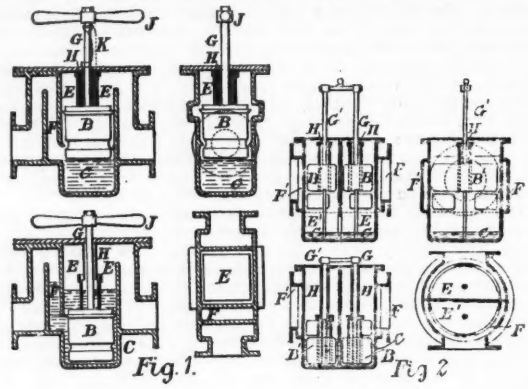


Fig. 1. Fig. 2

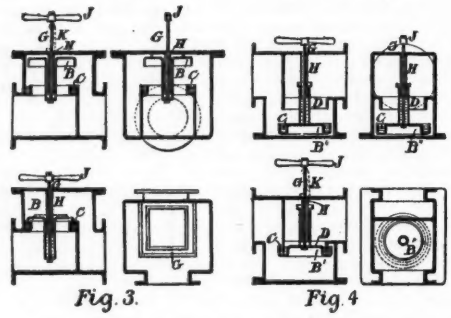


Fig. 3. Fig. 4

In fig. 2, the apparatus is shown with mercury as a seal, and employing only a small quantity of the liquid. It is constructed with two plungers or floats B B^1, with two corresponding chambers E E^1; the base or bottom of these chambers forming a shallow reservoir C for the mercury. E E^1 are divided by a diaphragm, with an aperture at the bottom connecting the two chambers. Between the inlet and outlet, there are formed chambers F F^1, separated from E E^1 by division-plates, with apertures in them through which the gas flows. The hollow rods G G^1 are guided by stays affixed to the bottom. The rods actuating the plungers B B^1 are connected together by a cross-head or other connecting-piece outside the valve chamber. Each spindle is surrounded by a sealing-tube H, and provided with mercury, forming a seal to prevent the escape of gas. The valve is opened and closed by raising and lowering the plungers B B^1. When they are lowered, they displace the mercury contained in the reservoir C, which rises in the chamber E E^1, and covers the aperture in the division-plate; thus preventing any flow of the gas through the apparatus from one chamber to the other.

Fig. 3 shows the apparatus constructed with a plunger B of inverted hollow or dish-shaped form, with downwardly projecting edges, which fit into a groove C, forming a reservoir to hold the sealing liquid. This groove is placed around the aperture through which the gas passes. When the valve is closed, the plunger covers the aperture, and the edge fits into the reservoir C, becoming immersed in the liquid therein, which is thereby displaced, and on rising forms a seal, and prevents the gas passing through. The rod G is provided with a tube H, to form a seal round it, and so to prevent the escape of gas.

The modification fig. 4, shows the operation of the valve or plunger reversed. The reciprocating piston or plunger B^1 is constructed with an annular groove or trough C, forming a reservoir for the sealing mercury. The lower edge of the aperture through which the gas passes is made with a flange projecting downwards, which, when the plunger B is raised, dips into the reservoir C; andthe mercury is thereby displaced to form a seal. The flange around the aperture may be sufficiently deep to touch the bottom of the trough, or a sealing may be otherwise formed in addition to the mercury seal.

In each case, the valve-spindle or rods G may be raised and lowered by a direct pull or thrust on the handle J; and when the handle and spindle are pulled up, they may be held in position by a pivoted catch K, which can be easily moved when it is desired to lower them. Provision is made, by removable plugs, sight-holes, or otherwise, by which the amount of sealing liquid present, or the level of it, may be ascertained at any moment and at any position of the valve plungers.

By this invention, the patentees consider they obtain the following advantages: (1) An efficient control of the flow of gases from gas, chemical, or other works, by means of the displacement or alteration of the level of a quantity of liquid. (2) The condensed liquid in gas-mains may be utilized for maintaining the valve always in working order; and the valve may be also used as a mains' drip-syphon. (3) The absence of racks, pinions, wedges, springs, facings, packing glands, or other accessories of the ordinary gas-valve.

Silencing the Exhaust of Gas-Engines, and Reducing Back-Pressure.—Paisley, J. R., of Colnbrook. No. 11,481; June 13, 1894.

The patentee proposes to connect to the exhaust-pipe of gas-engines a tank, into which is fixed a cylinder or chamber divided so as to form two compartments—the upper being the expansion chamber, with a diaphragm plate fixed below, having holes therein communicating with tubes extending to a suitable depth into the bottom compartment. This well is in connection with a water supply; and to the lower part of the well balance overflow-pipes are fitted. In order to seal the tubes in the well to a suitable height, there is an adjustable overflow-pipe in the outer tank. A vent-pipe is arranged in the well to carry off the fumes after passing the water seal; and in connection with the expansion chamber already mentioned, there is an inlet air-valve to prevent a vacuum occurring in the engine. Gas from the exhaust-pipe enters the expansion chamber, where its volume is broken up by the pipes through which it passes to the well. Escaping from these, it percolates through the water in the chamber. The effect of this is to deaden the sound which ordinarily occurs, to cool the gas, and to prevent exhaust charges of gas (which at times are not fired by the tube of the engine) from accumulating in the ordinary exhaust-boxes, and thus causing explosions. Finally, all the fumes pass up the vent-pipe. The height of the water-seal regulates the back-pressure as required.

Liquid Meters.—Tylor, J. J., of Newgate Street, London. No. 11,505; June 13, 1894.

The chief object of this invention is to provide means whereby the proper connection of the registering mechanism or clockwork of liquid meters with the actuating part can be verified before the case is put together, and (as far as the passage of small quantities of liquid is concerned) whether the clockwork is working properly.

For this purpose, the lower part of the casing of the meter, which contains the rotating fan and the inlet and outlet passages, is made shallower than heretofore; and the upper part, containing the registering mechanism or clockwork, correspondingly deeper. The joint between the two is at such a point that, when the upper part is removed, and the clockwork is in place, it is wholly exposed to view, so that every part of it, together with the central portion of the rotating fan, can be watched by the workman before and while the test for a small flow of liquid (not involving any material pressure in the meter) is being made. Of course, when the test for larger flows—involving pressure in the meter—has to be made, the upper part of the case has to be put in place. But as the proper connection of the registering mechanism with the actuating part, and the proper working of the clockwork, will have been previously verified during the test for small flows of liquid, it will be certain that such connection and working will be correct for the larger flows.

In the arrangements employed, the inner casing heretofore used in accordance with patents No. 10,443 of 1885 and No. 14,652 of 1887 may be dispensed with; but the brake arrangements, and the alternating projections or fillets and hollows or grooves therein referred to are preferably retained. The arrangement also allows of the meter being made more compact and of less weight than heretofore.

Pipe-Coupling.—Thompson, W. P.; communicated from A. Petrak and E. Vokac, of Ruklena, Austria. No. 4969; March 8, 1895.

This coupling is made by causing the ends of the pipes to be expanded by a conical plug driven in and then withdrawn; and in then inserting in the conically expanded pipe-ends a short piece of pipe double-tapered or double-cone shaped on the outside, and firmly pressing the ends of the pipes on to the middle piece of pipe by means of a screw coupling. The conical pipe is made of different material to that of which the two pipes which are to be coupled are composed. In the case of pipes made of hard material, a material possessing a considerably lower degree of hardness is selected for forming the core or middle piece of pipe, while with pipes made of soft material, a hard material is chosen for forming the insertion or core.

Lighting Devices for Railway Carriages, &c.—Fitzsimmonds, A., of Bury. No. 5351; March 13, 1895.

This invention has for its object to provide an arrangement by means of which the gas used for lighting railway carriages, &c., may be economized when the carriages are not occupied—the gas being turned very low when every person has left the carriage, and being turned on automatically on the entry of a passenger. This is effected by adapting the floor of the carriage to move slightly, and so operate, through suitable levers, a cock permitting of the free passage of gas. The seats are also connected to the same operating mechanism; so that as a passenger sits down, he will still keep the supply open—the seats being arranged to allow a slight motion similar to that of the floor.

APPLICATIONS FOR LETTERS PATENT.

8437.—Griffin, S., "Pipe-joints." April 29.

8500.—Smillie, R. D., Douglas, W., and Buchanan, W. R., "Pipes or tubes." April 30.

8529.—Mey, M. F. F., "Lamps." April 30.

8532.—Arndt, M., "Regulating the admission of air to furnaces according to variations in the weight of the furnace gases." April 30.

8552.—Prestwich, J. A., "Gas and other explosive engines." April 30.

8601.—Saintey, A., and Hardwick, J., "Pipe connector." May 1.

8615.—Arndt, M., "Indicating and registering the weight of gases." May 1.

8645.—Abel, C.D., "Production of new sulphonic acids derived from naphthalene, and of colouring matters therefrom." A communication from the Actien Gesellschaft für Anilin Fabrikation. May 1.

8709.—Roberts, W. R. W., "Strebor treatment of water-pipes." May 2.

8746.—Newman, A. R., and Somerville, J. M., "Manufacture of illuminating gas." May 2.

8886.—Prince, F. O'C., "Safety apparatus and means for feeding and vaporizing mineral oil when used for motive power and illuminating purposes." May 4.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Private Bills last week :—

Bills read a second time and committed: Cranbrook District Water Bill, Hayward's Heath Gas Bill, Scarborough Gas Bill, York New Water Bill.

Bills referred to a Select Committee, consisting of the Earl of Jersey (Chairman), Earl Grey, Lord Mendip, Lord Calthorpe, and Lord Kenny; to meet on Thursday, May 16: Barnsley Corporation Water Bill, Chesterfield Gas and Water Board Bill, Dewsbury and Heckmondwike Water Bill, Rotherham Corporation Bill.

Bills reported: British Gas Light Company (Staffordshire Potteries) Bill, Brymbo Water Bill, North Middlesex Gas Bill, Scarborough Gas Bill, York New Water Bill.

Bills read the third time and passed: British Gas Light Company (Staffordshire Potteries) Bill, Merthyr Tydfil Local Board Water Bill.

HOUSE OF COMMONS.

Monday, May 6.

LONDON WATER (TRANSFER) BILLS.

Dr. FARQUHARSON moved for the postponement till June 13 of the Chelsea Water (Transfer) Bill, which, with five other Bills promoted by the London County Council for the purchase of the London Water Companies' undertakings, was down for second reading.

Mr. BOULNOIS said the repeated adjournments of these Bills by the Council were extremely inconvenient, and displayed some amount of uncertainty on the part of the Council in regard to the great question of the London Water Supply. It was becoming clearer every day that it was not the intention of the Council to proceed with these six Bills during the present session. He was not revealing any secrets when he said they had been told on the Parliamentary Committee of the Council, by the agent who had been entrusted with the carrying of some of the Bills, that it was extremely doubtful whether it would be possible to deal with them this session. It would seem, indeed, as if it were the distinct purpose of the Council to tinker with the great water question of London. He hardly believed the House of Commons would consent to this course. It would be detrimental not only to the interests of the consumers, but to those of the ratepayers. Very large sums of money must be wasted by these adjournments. The longer the motion was delayed, the less probability was there of its being brought to an issue, because, as the House was aware, no Private Bill could go to the House of Lords after a certain date; and these repeated adjournments were driving them perilously near that date. This mode of harassing not only the Companies and the consumers, but the Local Authorities and Corporations interested in the question, was unworthy of the Council; and he therefore trusted the House would hear some specific declaration of policy on the part of that body in regard to the Bills, before they consented to the long adjournment which had been suggested.

Mr. STUART said the Bills had been adjourned once by a vote of the House, and another adjournment took place until the previous Friday. On that day, he regretted that personal circumstances, which he communicated to the hon. member for Marylebone (Mr. Boulnois) prevented his being in attendance at the House; and the hon. member and his friends who were opposed to the policy he advocated were kind enough to undertake to let the House know that any delay which then took place was due to those personal circumstances alone, and not to any action on the part of the County Council. With regard to the adjournment he now sought to support, he would mention that, when these Water Bills were adjourned, for the first time, he moved that their second reading should be postponed until May 3, and that they should then be further adjourned, if the two similar Water Bills now referred to a Select Committee were still under consideration. It was in fulfilment of that undertaking, given by him in the case of the Lambeth and the Southwark and Vauxhall Water Bills, that this motion for a further postponement was now made—these two Bills not having yet passed through Committee. There was no change of policy, and no wavering or uncertainty in the action taken in the matter. It was in these circumstances that it was desired to defer the consideration of the other six Bills until the Committee had had a reasonable opportunity of discussing and agreeing as to what the settlement was to be in the case of the two Bills already referred to them. It had been hoped that it would have been possible for the Bills to have been set down for May 3; but a great many members desired that the new Council should pronounce an opinion before the two Bills went before the Committee. He assured the House at the time of the second reading that it was unnecessary to wait for any expression of opinion by the new Council, after the strong one given by the old Council; and he was glad to see that, when this question was brought before the present Council, they, by a majority of more than two to one, voted in favour of the policy he was now asking the House to adopt.

Mr. BANBURY entered a protest against the repeated postponements of these Bills. He said the interests of Londoners and of the shareholders were suffering from the extraordinary method of procedure adopted; and he hoped that either all the eight Bills would be taken before the Committee, or the whole thing be dropped.

The order for second reading was then postponed.

The following progress was made with Private Bills last week :—

Bill presented, read the first time, and referred to the Examiners: Local Government Provisional Order (Gas) Bill, to confirm an Order relating to St. Ives, Cornwall.

Bills reported: Brighouse Corporation Bill, Edinburgh and District Water Bill, Hebden Bridge and Mytholmroyd Gas Board Bill.

Bill read the third time and passed: Bray Township Improvement Bill.

Last Wednesday, the House of Commons Committee on Police and Sanitary Regulations had under consideration the Brighouse Corporation Bill, one of the objects of which is to enable the Corporation to purchase the Rastrick Gas-Works. Clauses were passed authorizing the expenditure on the gas undertaking of £52,000, which was made up of £47,500 for the purchase, £2800 for the debt, £1000 for the relinquishment of the interest of the Halifax Corporation in the supply to Hove Edge, and £700 for the costs of the transfer; authorizing the expenditure of £29,000 on the gas-works during the next 15 years, £23,200 of which is to be spent on the Brighouse works, and £5850 on the Rastrick works. A sum of £10,000 was also authorized to be spent for water-works purposes. A clause providing for the levying of rates in instalments was accepted by the Committee, as was also one empowering the Corporation to award to their servants a gratuity not exceeding one year's pay for accident, old age, or infirmity, or to the widows in case of death. The other clauses were settled by the Committee; and the Bill was ordered to be reported.

The Report of the Board of Trade Committee on Standards for Testing the Illuminating Power of Coal Gas, with the Appendix, was presented to both Houses of Parliament last week.

Reduction in Price.—The Bromsgrove Gas Company have decided to reduce the price of gas 4d. per 1000 cubic feet.

The Hours of Labour at the Stockton Gas-Works.—The Gas Committee of the Stockton Corporation have been considering the question of the hours of labour of the stokers at the gas-works; and they have come to the conclusion that the eight-hour system cannot be adopted without serious loss to the ratepayers.

Warrington Corporation Gas-Works.—The Warrington Town Council last Tuesday empowered the Town Clerk to take steps to enable the Council to borrow £20,000 to meet the estimated cost of closing the Mersey Street works for the manufacture of gas at an early date. It was stated that there was a loss on the working at Mersey Street; and it was proposed to manufacture the gas at Longford.

Lancaster Corporation Gas and Water Departments.—At the monthly meeting of the Lancaster Town Council on the 1st inst., Mr. H. W. Helme, in moving the adoption of the minutes of the Gas Committee, stated that they had only received about 40 applications for prepayment meters; and of this number, nearly half were from occupiers of houses of more than £9 rateable value. Most of them came from the inhabitants of cottages rated at about £12; and the Committee asked the Council to authorize them to extend the placing of the meters in such houses above £9 rateable value as they might think fit. With regard to the finances of the department, the Committee proposed to carry the whole of the debit-balance of the renewal fund to the capital account. Concerning the past year's working, the Finance Committee proposed to transfer £1000 from the gas-works profits to the borough fund. The motion was carried. Afterwards Alderman Huntington announced that £2500 was to be taken from the profits of the water undertaking towards the relief of the rates.

Southampton Gaslight Company.—The shareholders of this Company met on the 1st inst., for the purpose of receiving the half-yearly report of the Directors. This announced that the profit and loss account showed an amount of £11,975 available for dividend. The Directors recommended the payment of the maximum dividends for the half year, which would absorb £8227, and leave £3748 to be carried forward. Mention was also made of the sale by auction, on Feb. 15 last, of £5000 of 5 per cent. perpetual debenture stock, which realized £7152; being an average of £143 0s. 9d. per cent.—the premiums amounting to £2152. The new works for which this capital was required, were, it was stated, nearly completed, and would be available for use next winter. During the half year, there was an increase of 8,218,000 cubic feet of gas sold, as compared with the December half of 1893. For the whole of 1894, the increase was 17,322,000 cubic feet. A further reduction of 2d. had been made in the price of gas throughout the whole district, from the commencement of the current quarter, bringing down the price to 2s. 6d. per 1000 cubic feet in the town district, and to 3s. in all the outlying districts. The Chairman (Mr. R. C. Hankinson), in moving the adoption of the report, expressed regret that, for the first time for many years, the Secretary (Mr. C. Crowther Smith) was prevented attending the meeting through indisposition. Mr. Smith had had a serious illness, and had had to submit to a severe, though not dangerous, operation. He was, however, making fair progress to recovery, and hoped to resume his duties in a few days. As to the report, the actual profit had been larger than, he believed, in any previous half year—amounting to above £9000; and there had been a great increase in the sale of gas, which was not confined to any one particular district. The Directors had been able to make a favourable coal contract; it was at a price lower than that of last year, and was for three years. Taking all things into consideration, he thought they had every reason to believe the Company were going on in a prosperous way. The Directors had reduced the price of gas by 2d., which meant a loss of £2874 per annum. The exhibition of gas appliances, which they had recently held, had increased the use of gas cookers; nearly fifty more having been fixed at a rental. This was a direct result of an exhibition, but what the indirect results had been, no one could tell. As to the consumption of gas, in 1894 it amounted to 345 million cubic feet; in 1884 it was 224 million. This increase of 121 millions was at the rate of 54 per cent.; but the increase of the capital during the same period was only 38 per cent., which was an important feature. The reduction of 2d. cost them £1000 more than it did ten years ago. The dividends in 1884 amounted to £12,934; but in 1894 they came to £16,329—the increase being caused by the raising of new capital, which had been expended chiefly in new works. Dr. Sampson, in seconding the motion, congratulated the proprietors on the prosperous condition of the concern. Although the electric light was making way, gas was also doing the same; and there was no reason why the two should not go hand in hand, and prosper. Their Manager (Mr. S. W. Durkin) kept himself fully alive to all that was being done in this direction. The motion was adopted.

MISCELLANEOUS NEWS.

THE LONDON COUNTY COUNCIL AND GAS-METER RENTS.

Our readers may remember that, early in the present year, the Public Control Committee of the London County Council had referred to them to report whether the meter-rents charged by the Gas Companies were or were not in excess of those sanctioned by the statute, and to make suggestions accordingly. The Committee report as follows: "We are advised that, by the Metropolis Gas Act, 1860, the rent is limited as regards meters not exceeding five lights to 10 per cent. on the net cost of such meters. With respect to the rent for meters exceeding five lights, there appears to be no statutory limit. We are informed that, based on the cost price as given in the price-lists of a well-known firm of London meter makers, an average charge of 10 per cent. on meters of the following sizes would be: 1-light, 2s. per annum; 2-light, 2s. 10d. per annum; 3-light, 3s. 6d. per annum; 5-light, 4s. 6d. per annum. The number of 1 and 2 light meters in use in London is extremely limited. Our report may therefore be confined to 3 and 5 light meters, the Gas Companies' charges for which are as follows: South Metropolitan Gas Company, 3-light, 3s. per annum; 5-light, 4s. per annum. Commercial Gas Company, 3-light, 2s. per annum; 5-light, 3s. 4d. per annum. Wandsworth and Putney Gas Company, 3-light, 2s. 8d. per annum; 5-light, 3s. 4d. per annum. Crystal Palace District Gas Company, all sizes, 3s. per annum. Brentford Gas Company, 3 and 5 light, 6s. per annum. The Gaslight and Coke Company have ceased to make any charge for meter-rents since the 31st of March last. The Wandsworth and Putney Gas Company, the Crystal Palace District Gas Company, and the Brentford Gas Company do not come under the provisions of the Metropolis Gas Act, 1860. It will be seen that the rents charged for meters by the two remaining Companies are within the limit as calculated on the above figures. It does not therefore appear to us that any suggestions on our part are necessary."

GAS PROFITS AND CONSUMPTION AT MANCHESTER.

At an Adjourned Meeting of the Manchester City Council last Wednesday, Alderman Higginbottom made a statement regarding an allegation which had been advanced that the excessive consumption of gas in the March quarter of the past financial year had been caused by unfair means. The facts which he supplied would, he said, dispose of that charge. A comparison of the consumption of gas in the daytime in the months of January, February, and March, 1894, with the consumption in the corresponding period of this year showed that in the three months of the March quarter, 1894, the consumption of gas in the daytime was 267,203,000 cubic feet, as against 345,481,000 cubic feet in 1895, or an average increase of 29·55 per cent. The average increase during the night was only 4·14 per cent., or about the usual and normal rate owing to a greater number of consumers. The real increase in the consumption had therefore been in the daytime; and it arose from the fact that people had burned gas in their chambers, bath-rooms, and in various ways with a view of preventing the freezing of pipes. It was, he said, also alleged against the Committee that extra pressure had been put on, and that gas had thus been forced through the pipes at a higher rate than could be consumed. As to this, figures which had been prepared showed that the actual district pressure was a shade lower in 1895 than in 1894. In January, February, and March this year, the average day pressure was 1·48 inches, as against 1·53 inches last year; and the average night pressure was in 1895 1·73 inches, as against 1·79 inches last year; so that it would be seen the pressure for the three months this year had been less than in the corresponding period last year. It was less because the great demand for gas was such that they had not the gas in the stations to meet it; and they were obliged to keep down the pressure for the purpose of maintaining the supply even at a decreased pressure. Then the temperature had to be considered; and there again the returns as to temperature showed that for the first three months of 1895 it was enormously lower than in 1894, and that the number of dull, foggy days, and very cold days, was greatly in excess in 1895 over the same period of 1894. A dark day had an immense effect upon the consumption, which would jump from an ordinary winter day's consumption of 4 million cubic feet to nearly 8 millions, and this without any increase whatever in the district pressure. These facts accounted for the whole increased consumption. There had never been any difference made in the deposit charge, which was the same as it had been for some years past. No inducement was given to the gas collectors to increase the bills for gas. They were paid by salary and had no commission; and the bills were made out, not by them, but in the office. The Gas Committee had done nothing wrong; they had charged only for the gas consumed. As to the increased profit of £34,000, he pointed out that £18,000 of it was owing to the purchase of coal at a cheaper rate than was at first contemplated.

ARTIFICIAL ILLUMINANTS IN USE IN DUKINFIELD.

The Gas Engineer of the Dukinfield Urban District Council (Mr. Harrison Veevers, Assoc.M.Inst.C.E.) has presented to the Gas Committee an interesting report on the subject of the use of artificial illuminants in the town. It may be remembered that, in December, 1886, Mr. Veevers made a similar report, giving statistics of the number of houses supplied respectively with gas, paraffin, and candles. The report furnished results which excited some surprise. It showed that, out of 3820 inhabited houses, there were 2196, or 57½ per cent., in which the occupants were using gas; 1600, or nearly 42 per cent., where they were burning paraffin; and 24, or 0·5 per cent., where they were content with the humble candle. He made some suggestions as to how to meet the competition of paraffin by the adoption of more frequent collection of money from cottagers burning gas. This report naturally excited some discussion throughout the country; and it finally produced an unexpected, but satisfactory, conclusion in the invention of the prepayment meter. In January last, the Committee authorized Mr. Veevers to take a census of the number of houses consuming gas, paraffin, or candles. This time, he enlarged the inquiry so as to ascertain why paraffin was preferred to gas, and why gas was not used. The results show that there are 4124 inhabited houses in the urban district of Dukinfield, and that, of these, 2505, or 60 per cent., use gas; while 1613, or 40 per cent., burn paraffin, and only 6 indulge in candle light. There have been fixed in Dukinfield this year 135 prepayment meters. These consumers of gas would have been otherwise users of paraffin. In this case, the percentages would have been 57½ burners of gas and 42½ burners of paraffin; being a greater proportion of the latter than nine years ago.

The following particulars are the result of the inquiry instituted: 15 will now burn gas, using ordinary meters; 122 will now burn gas, using prepayment meters; 82 will consider the question of having prepayment meters; 152 prefer gas, but have defective fittings, which in most cases the landlord will not repair; 681 are either without internal fittings or services, or both, and would most likely burn gas if fittings were provided; 50 burn both gas and paraffin—considering gas to be too expensive; 34 non-consumers contemplate removing from their houses; 60 prefer gas, but consider it to be too dear; 23 have used gas, but, chiefly through having defective fittings, the gas accounts were too large; 66 cannot afford to burn gas, being too poor or out of work; 3 consider gas is too poor, and not worth using; 45 prefer paraffin because it is cheaper; 14 consider gas to be injurious to plants; 11 consider it to be injurious to health; 4 consider it to be injurious to birds; 3 consider they have been unjustly charged in their gas accounts, and had quarrels with the officials about 20 years ago; 41 prefer paraffin and never used gas, and some sell the oil; 96 prefer paraffin because it gives a better light than gas; 111 give no reason why they prefer paraffin; and 6 burn candles only.

Mr. Veevers remarks that the foregoing particulars are interesting and instructive, and show a field worth cultivation. It is evident, he says, that offering such inducements as furnishing houses with gas-fittings, and perhaps providing a small cooker or a boiling-burner, might induce some of the 681, and others mentioned in the above list, to become consumers of gas. The cost of doing this might be borne by the Council, and be recouped by a rental or by a quarterly repayment, as in the present system of disposing of gas-cookers. Ordinary meters are now supplied in Dukinfield, free of charge to small consumers; and the extra cost of prepayment meters and gas-fittings might be repaid as above described. In most places, the plan is to charge an extra price for gas—say, 4d. or 5d. per 1000 cubic feet more than is paid by consumption through an ordinary meter. This plan Mr. Veevers does not consider to be a fair or an equitable one, for the simple reason that a consumer of a small quantity does not pay enough to recoup the Council, while a large consumer pays too much, and so becomes discouraged. One tenant possibly only burns 1000 cubic feet yearly, and he would only pay 5d.; while another, who consumes 10,000 cubic feet, would pay 4s. 2d. He thinks perhaps the best plan to adopt would be to charge 6d. per quarter for the rent of a prepayment meter; and for any fittings supplied, such a sum per quarter as would repay the cost in four years, when the fittings would become the property of the consumer. Mr. Veevers had supplied to him by Mr. Isaac Carr, of Widnes, very full information of the cost of gas-fittings for houses, founded on actual experience. In one case, a house supplied complete, from meter to burners—comprising piping, labour, two pendants, one boiling-burner, and two brackets, but exclusive of main tap and prepayment meter—cost 31s.; and another house, 32s. 6d. In these cases, a rental for meter of 6d. per quarter, and a hire-purchase charge of 2s. per quarter for four years, would, Mr. Veevers thinks, repay the Council, and increase the consumption of gas. He considers that the present is a favourable time to take action. The price of gas has been reduced to 2s. 11d. per 1000 cubic feet to small consumers, and the cost of paraffin has risen considerably.

With respect to prepayment meters, Mr. Veevers informs his Committee that, since their introduction about five years ago, the meter makers in England and Scotland have supplied upwards of 105,787 of them. He ascertained this fact from the meter makers themselves. He points out that some of the largest and most enterprising gas undertakings in the United Kingdom have adopted them; and the enhanced cost of paraffin, and the evident advantages of gas, must, he thinks, increase the demand. Nor should the supplier of gas object to their use. He receives payment before delivery, avoids the unpleasantness of collecting, and the disappointment of bad debts. He quotes an interesting letter he received from Mr. W. A. Valon, of Ramsgate, who stated that in three years he fitted up 800 houses with prepayment meters, and had thus added one-fourth to the number of consumers from people who could never otherwise have burned gas owing to the first expense of fitting. It might be objected that there was extra cost incurred in collecting the money from the boxes; but Mr. Valon claimed that this frequent visiting had the advantage that, should a consumer have any complaint, or require any advice, he was in constant communication with the inspector. In the case of Dukinfield, this had been proved in the taking of this census. The inspector who had made the house-to-house visitation had procured 137 consumers, and a probable addition of at least 82 more.

Mr. Veevers concludes by emphasizing the fact that a gas undertaking, to be prosperous, must work on the lines of a manufacturing concern; the advantages of the goods supplied being presented to probable customers. Orders should, he says, be solicited by an inspector properly qualified to contend with the rivalry of paraffin. Before the introduction of cheap substitutes for gas, gas undertakings had a monopoly of artificial lighting; but with the advent of paraffin, this monopoly ceased; and it has become necessary for the owners of gas-works to meet the opposition by proving the convenience and economy of gas, not only for light, but also for heat, and consequently power.

The above report was included in the minutes presented by the Gas Committee at the meeting of the District Council yesterday week; and, on the motion of the Chairman (Mr. J. Halstead), they were adopted, without discussion.

STALYBRIDGE GAS SUPPLY.

The Engineer's Report on the Past Year's Working.

The Gas Engineer and Manager of the Stalybridge Corporation (Mr. E. A. Loam) has lately presented to the Gas Committee his report on the working of the gas undertaking in the year ending March 25 last. We take the following extracts therefrom :—

The quantity of coal and cannel carbonized was 13,009 tons 6 cwt., against 13,070 tons 18 cwt. 2 qrs. in the year 1893-4, or a decrease of 61 tons 12 cwt. 2 qrs. The make of gas per ton of coal was 10,874 cubic feet, as compared with 10,548 cubic feet. The total bulk of gas made was 141,469,000 cubic feet, against 137,883,300 cubic feet, or an increase of 3,505,700 cubic feet. The quantity sent out was 141,290,600 cubic feet, as compared with 137,874,200 cubic feet, or an increase of 3,416,400 cubic feet. The quantity sold per ton of coal carbonized was 8694 cubic feet, against 8377 cubic feet, or an increase of 317 cubic feet per ton. The cost of coal, after deducting the amount received for residuals, was £4836 17s. 5d. ; and the working expenses came to £6365 7s. 4d.—making the total cost £11,202 4s. 9d., against £11,988 0s. 1d. in 1893-4, a decrease of £785 15s. 4d., or equal to 17s. 2·67d. per ton, against 18s. 4·12d. in the preceding year. The average illuminating power of the gas was 19·07 candles. The coke sold amounted to 4739 tons, as compared with 3871 tons, or an increase of 868 tons; the tar and liquor sold was 2524 tons, against 2491 tons, or an increase of 33 tons. Referring to the maximum consumption in the months of November, December, and January last, Mr. Loam finds the days and figures to be as follows: Nov. 30, 791,600 cubic feet; Dec. 5, 831,200 cubic feet; Dec. 19, 795,000 cubic feet; Dec. 21, 838,800 cubic feet ; Dec. 24, 835,100 cubic feet ; Jan. 17, 1,000,300 cubic feet—this being the largest daily quantity ever sent out for consumption. The largest weekly consumption for the past financial year was 4,942,400 cubic feet.

Mr. Loam again draws the attention of his Committee to the important question of the burners very often used by consumers of gas ; these being, he considers, the real cause of complaint made about the quality of gas. He says he is convinced that, if suitable modern burners were used instead of the old metallic jet, all consumers would be more satisfied. He regrets that the leakage account is rather high ; but, in his opinion, some of the loss may be accounted for by the wide area supplied requiring long lengths of main to serve a scattered district. Another cause is the high pressure at which the gas is sent from the works, which is necessary in order to furnish a proper supply throughout the district. All services and mains are, he says, being thoroughly examined ; and every effort is being made to reduce the leakage.

The use of gas for cooking, heating, and motive power has been encouraged in every possible way. Mr. Loam trusts the introduction of good stoves will lead to a large increase in the consumption of gas as an agent for cooking and heating. As during the late severe weather serious escapes of gas and explosions were reported from all parts of the country, Mr. Loam offers a few words of caution to ensure safety. He concludes his report by saying he considers the year's working very satisfactory ; and he assures the Committee that no effort will be wanting on his part to make the current year even more favourable.

The minutes of the Gas Committee, which embraced the above report, came before the Town Council at their meeting last Tuesday, and led to a protracted discussion. This will be noticed in next week's issue.

STREET LIGHTING BY INCANDESCENT GAS-LAMPS.

Proposed Large Installation at Ipswich.

The Ipswich Corporation Paving and Lighting Committee have recently had before them a report by their Gas Inspector (Mr. E. C. Sayer) as to the adoption of the incandescent system of gas lighting in the borough. The document first described the incandescent gas-light, and compared its illuminating power with that of various other burners. The results may be briefly stated as follows: Bray's No. 4 batswing burner, with a consumption of 5 cubic feet per hour, gave an illuminating power of 4·8 candles ; No. 5 ditto, with 6 cubic feet consumption, gave 9·6 candles ; an ordinary street governor, with 6 feet consumption, gave 14 candles ; an ordinary Argand burner, with 5 feet consumption, gave 15·8 candles ; the Welsbach burner, glass chimney, with 3·75 feet consumption, gave 68·4 candles ; ditto, with mica chimney, with 3·5 feet consumption, gave 60 candles ; ditto, after three months' use, with 3·75 feet consumption, gave 40 candles ; and the Belge oil-lamp, with a consumption of 2 oz. of oil, gave 16 candles. Mr. Sayer stated that a mantle in constant use for three months satisfactorily maintained its illuminating power, which was three times as great as the best ordinary gas-burners or the incandescent electric lamp, each of which did not generally exceed 16-candle power, unless very great expense was no object to the consumer. He was far from saying that the incandescent system of gas lighting had now been brought to the highest pitch of perfection ; still he was bound to regard it as a system of gas lighting which utilized, most efficiently and economically, the full powers of coal gas as an illuminating agent. The cost of each street-lamp burning 5 feet of gas per hour was now: Gas, £2 9s. 4¾d. ; lighting, extinguishing, and cleaning, 17s.—total cost per annum, £3 6s. 4¾d. If the incandescent system were adopted, the consumption of gas would be somewhat less, and the cost as follows: Gas, £2 0s. 5½d. ; lighting, extinguishing, and cleaning, £1—total, £3 0s. 5½d. This, however, would be exclusive of renewals of mantles and chimneys. Assuming each burner needed six mantles, six mantle rods, and two glass bowls per annum, the total annual cost per lamp would be £3 11s. 2d., which is 4s. 9¾d. more than the present cost. There are 820 lamps burning 5 cubic feet per hour ; and the additional cost would be £197 6s. 3d. The introduction of incandescent burners would, however, enable the Authority to reduce the consumption of gas in 57 large lamps, of which 34 now burn 7 feet, and 23 10 feet per hour. This would effect a saving (allowing for the 57 incandescent lamps which would take their place) of £76 15s. 8d., and gave £120 10s. 7d. as the probable net additional cost of adopting incandescent burners in 877 of the public lamps. Mr. Sayer had every reason to believe the Gas Company would fall in with this arrangement ; and the borough would then lose the stigma of being the worst lighted town in the Eastern Counties. The Committee resolved to recommend the Council to carry out the suggestions set forth in the report, and that an extra sum of £120 be provided in the estimate for public street lighting for the ensuing year for this purpose. At a subsequent meeting, the Town Clerk stated that he had received a letter from the Secretary and Engineer of the Company (Mr. J. T. Jolliffe) which somewhat modified the terms set forth in the report ; and on its receipt, he wrote to the Chairman, and, with his approval, no report had been presented to the Council. It was determined to consider Mr. Jolliffe's letter in private.

SELBY GAS SUPPLY.

Under the able management of Mr. M. Dunn, the Gas Department of the Selby District Council presented very satisfactory results at the close of the past financial year. The quantity of gas made was 23,071,000 cubic feet, as compared with 21,851,000 cubic feet in 1893-4—an increase of 1,220,000 cubic feet. Of the total make, 21,660,900 cubic feet were sold ; leaving 1,410,100 cubic feet unaccounted for. The leakage was reduced from 6·22 to 6·11 per cent. The bulk of coal carbonized was 65 tons 17 cwt. in excess of that used in the preceding year ; but the make of gas per ton was also higher—10,711 cubic feet, as compared with 10,452 cubic feet, or 259 feet more. The gas sold was 10,060 cubic feet per ton, against 9813 cubic feet—an increase of 247 feet. With respect to residuals per ton of coal carbonized, the sale of coke was higher by 1 cwt. ; the tar realized 2s. 0½d. ; and there was a yield of 35 gallons of 5° Twaddel liquor. The net profit on the year's working amounted to £1449 9s., or equivalent to 7·88 per cent. on the capital employed. The use of gas is not falling off at Selby, for last year there was an addition to the extent of 10 per cent. to the number of consumers ; and, quite lately, more than 30 gas cooking-stoves have been fixed. In view of the stable condition of the undertaking, the Council are contemplating a reduction in price from 3s. 3d. to 3s. per 1000 cubic feet. To meet the rapidly increasing demand for gas, the Council have agreed to further extend the retort-bench, enlarge the retort-house, erect a new annular condenser, purchase a 6-horse power gas-engine, and provide complete testing apparatus. About 3 miles of new mains are to be laid this summer, to supply outlying districts lately annexed to the township. The accounts of the Gas Committee were presented to the Council on the 1st inst. ; and the eminently satisfactory state of affairs they revealed called forth deservedly favourable comments from a local paper. In view of the carping criticism to which gas companies and committees are sometimes subjected, it is pleasant to read an acknowledgment by the Press that at Selby the inhabitants are to be congratulated on possessing on their Gas Committee careful administrators, and in their Gas Engineer a thoroughly capable officer, whose combined efforts have resulted, by the production of a substantial balance, so happily for the general welfare of the town.

EXHIBITIONS OF GAS APPLIANCES.

During the four days ending the 3rd inst., Messrs. W. Parkinson and Co. held a very successful exhibition of their gas appliances for domestic uses at the Town Hall, Luton ; and practical lessons in cookery were delivered twice daily by Miss Sanderson. The same firm were exhibiting three days last week in the Public Hall, Stevenage, with Mrs. E. A. Springthorpe as cookery demonstrator. An interesting exhibition, arranged by the Sheffield United Gas Company was opened last Tuesday, in the Skating Rink at Sheffield ; and the goods will remain on view until next Saturday. The Gas Company occupy a stall in which they display a large assortment of fittings for the incandescent light ; and hanging from the roof are a number of "Vertmarche" regenerative lamps. The two sides of the building accommodate exhibits supplied by the Davis Gas-Stove Company, Limited, and Messrs. Richmond and Co., Limited. Lectures on cookery are delivered by Mrs. Brightwell, of the Sheffield School of Cookery.

A four-days' exhibition, promoted by the Kendal Corporation Gas and Water Committee, was brought to a close last Thursday. It was on an extensive scale ; and many of the large makers of gas appliances were represented. Conspicuous among the exhibitors of gas cooking and heating stoves were Messrs. Fletcher, Russell, and Co., Messrs. J. Wright and Co., and Messrs. Richmond and Co.

The Davis Gas-Stove Company's exhibits at the Food and Cookery Exhibition in London have resulted in their obtaining a diploma for a gold medal. An exhibition of the gas-stoves, heaters, and cookers made by Messrs. R. and A. Main, of Glasgow, was opened in Hamilton on Monday last week, by Mr. Brown, the Convener of the Corporation Gas Committee, who said that, since they held their very successful exhibition last year, the Corporation had fitted up 111 gas-stoves in the town, besides those which had been fixed by tradesmen.

St. Petersburg New Water-Works Company, Limited.—In the Chancery Division of the High Court of Justice a few days since, Mr. Justice Chitty made an order, on the petition of the above-named Company, sanctioning resolutions already passed for the reduction of the capital from £200,000 to £130,000.

Failure of the Gas Supply at Malvern.—Some inconvenience was caused to the gas consumers of Malvern during the evening of Monday last week, owing to an accident at the gas-works. About four o'clock there was an explosion, which blew out the walls of the governor-house ; and the roof fell in upon the two governors, damaging them so badly that one was entirely disabled, and the other could not be brought into use until a late hour. In the higher parts of the town, the gas held out for some time ; but the lower portions were unlighted, and there was no public lighting. Men were working near the governor-house at the time of the explosion ; but fortunately no one was injured.

SINGAPORE GAS COMPANY, LIMITED.

The Annual Meeting of this Company was held last Thursday, at the Cannon Street Hotel, E.C.—Mr. SAMUEL SPENCER in the chair.

The SECRETARY (Mr. R. M. Christie) read the notice calling the meeting; and the report and accounts for the half year ending Dec. 31 last, which were referred to last week, were then submitted.

The CHAIRMAN, in moving the adoption of the report and accounts, said that, at the last meeting of the shareholders, he ventured to say that he thought they had turned the corner of the previous two years' very disastrous trading, which had deprived them of the smallest dividend. The sales at that time had been slightly better; and their position was due entirely to the great loss they had suffered from the fall of the dollar. He was pleased to say their position had been to some extent improved (as the report stated) by all the items having increased—especially in regard to coke and tar, and a better return from the price charged to the private consumers. Coal had also been purchased at a lower price; and the net result was that, although the rate of exchange was slightly lower than it had ever been, they had netted an income which enabled the Directors to say that, on the half-year's working, there was a decided improvement in the profit made. They recommended (and he hoped with the shareholders' approval) that, for the half year, no dividend be declared, as it would allow them to write off 1 per cent. for depreciation, and also to reduce the amount of the stocks to a sum that their Manager (Mr. H. W. Smith) considered would cause every penny to be represented at its true value. At the last meeting, he (the Chairman) expressed the opinion that silver had touched its bottom price; and now, six months later, he felt convinced it was so. He was confident that, at 27d. per ounce—the price of silver six months ago—there was little or no profit in silver mining; and the tendency must be for the price to improve, rather than go lower. They had now the satisfaction of seeing a better price (above 30d. per oz.) than the low rate of a few weeks ago; and his own opinion was that it would remain at something like this figure. He mentioned this to show that, if silver kept at about its present rate—say, 1d. or 2d. up or down—the Company's position in the future would be fairly steady, as, with the increased price for public and private lighting, and the prospect of securing coal at its now moderate cost, the Directors thought—and they said it with much hopefulness—that the resumption of dividends might be expected at the next meeting, and that they would be such as would satisfy the shareholders. Towards attaining this desirable position, he could not help thinking they would benefit from gas being more largely used now, as the price of oil had increased so greatly; and, according to the reports in circulation, the increase was likely to continue. Only a few days ago, he read that there was no immediate prospect of a fall in price, and that, as the American oil trade had been so enormously pushed, and the oil was now in such scarcity (their stocks for 1892 having run down from above 17 million barrels to under 5 million barrels this year), Russian oil will have to be depended upon to make up the deficiency. It was also said by an expert that, if the price was increased much more, lighting by gas, or even candles, would be cheaper than with oil. He was pleased to say that the Company were working on quite friendly terms with the Municipality, and that the extra price they had had to arrange with the Government had not prevented them extending the lighting—in fact, during the past half year some 40 extra lamps had been erected; bringing the number now in use to upwards of 1000. During the past half year, their Manager had had a very trying time; and the Directors felt sure a special vote of thanks would be heartily given him for having brought the Company through it so well. In a letter received from Mr. Smith in the previous week, he said: "The sales for the first three months of the current half year show a marked improvement; and our prospects are most hopeful." He (the Chairman) thought the shareholders would consider the report fairly satisfactory; and the best thanks of the Directors were due to them for assisting, by their patience, to bring the concern into its present state. In conclusion, he drew attention to the item of creditors amounting to only £1945, as against £2354 of cash in hand—a position which, he said, spoke volumes as to the soundness of the Company.

Mr. B. GREEN, in seconding the motion, referred to the great improvement which had been made in the accounts since the last meeting. The stocks had been written down considerably; and the sundry creditors were about half what they were this time last year. He thought, however, the Chairman was a little too sanguine, and promised rather more than he should like to do. There were one or two little things he (Mr. Green) wished to see removed before they talked about a dividend; and if the shareholders would only bear with the Directors one half year more, he thought they could faithfully promise a dividend.

Mr. DEANE believed the Company stood in a unique position among gas companies in being two years without a dividend. The Directors congratulated the shareholders upon the better position of their affairs; but the accounts seemed to him to continue much the same. At June 30, 1893, the balance was £1067; the next six months, they gained £7; the following half year, they lost £17; and now the accounts showed a gain of £12. He suggested that a little fresh blood was required on the Board. He moved that a dividend of 2 per cent. be now paid, which would leave about £400 to be carried forward.

Mr. ROBBINS sympathized somewhat with the remarks of the last speaker, and called attention to the low price to which the shares had fallen. He noticed that £708 had been written off in the present accounts for depreciation of plant; and he asked why, if the works were kept in good order out of revenue, it should be necessary to mulct the accounts for one half year to that extent. It seemed to him the expenses were very heavy. While the wages only amounted to £1000, salaries and collectors' commission came to £1414, in addition to £210 for Directors and Auditors, and £260 for rent, rates, and taxes. He suggested that the Directors might systematically go through these items, and see whether some reduction could not be made. He also alluded to the amount at the bankers' in London and Singapore—£2043—and said that, as the shareholders were foregoing a dividend, the money ought to be put to some useful purpose.

Mr. DYER agreed with the remarks of Mr. Green. Two years since, he (the speaker) called attention to the fact that sundry creditors stood at £8700; and the fact was then elicited that the Company owed a large amount of money, and were still in a state of insolvency. On that occasion, he moved an amendment that the report and accounts should be adopted, with the exception of the paragraph relating to the dividend; for he felt that, if the Company were allowed to go on in that condition, not only would they have no dividend, but they would have no capital. The present Directors were putting the concern on a firm footing; and if the shareholders would bear with them a little longer, he was sure they would obtain a continuous dividend.

Mr. W. T. BATTEN replied to the discussion. He said that, when he was at Singapore, he entirely disagreed with the policy of the then Board. They were not only paying away all they were making, but they were running the concern very close to the edge of bankruptcy. Changes had been made in the constitution of the Board; and the present members were determined to do all in their power to pull the concern round. He could not agree that the Company were in the same position as they were six months ago. They had written off £1500; and the item of sundry creditors had been brought down from £5713 to £1945. The stock of coal, too, was practically as large now as then. As to paying a dividend, they had raised the price to the private consumers, and they had a better price from the Municipality for the public lamps; but the latter would not come into operation until next half year. He hoped then they would be able to propose a dividend. As to the question of salaries and wages, the salaries included the remuneration of Europeans. They paid the men there less than £1 a month —$7 a month; and at present it took over $9 to make £1.

Mr. Deane then withdrew his amendment; and the motion was unanimously carried.

On the proposition of the CHAIRMAN, seconded by Mr. DYER, Mr. A. E. Stevenson was re-elected a Director; as was also Mr. B. Green, on the motion of Mr. R. GARRAWAY RICE, seconded by Mr. SAMSON.

Mr. T. A. GREENE moved the re-appointment of the Auditors (Messrs. Magnus Ohren and T. Guyatt).

Mr. H. J. ROBUS seconded the motion; and it was unanimously passed.

The services of the Chairman and Directors and of the Secretary, Engineer, and staff were duly acknowledged.

ELECTRIC LIGHTING NOTES.

The electric lighting undertaking at Morecambe is not in a very flourishing condition. The report of the Directors of the Company supplying this well-known Lancashire holiday resort was issued a short time ago; and it came before the shareholders at their meeting on the 4th inst. The gathering was not numerous; but—possibly to prevent the chance of inconvenience from overcrowding—the reporters were politely requested to withdraw, as the meeting was said to be "for shareholders only." They were, however, informed that minutes of the proceedings would be supplied to them on making application at the Company's office; and, on doing so, they were told that the report and balance-sheet had been adopted. On asking for a copy of the report, they were informed that the Directors declined to furnish one. All this seems to point to the existence of a condition of affairs which the Directors were desirous of "keeping dark." But, unfortunately, things will leak out; and in due course the report made its appearance in a local paper—as it naturally would, in these days of journalistic enterprise. Reporters having been excluded, we do not know what transpired before the report was adopted; but we have reason for believing that the remarks from the shareholders' side of the table were not complimentary to the Board. It may not be uninteresting to look for the reason of this. And we will begin by taking the statements contained in the report. The very first is a confession that the working last year resulted in a loss of £424. We are told that the fitting-up department was conducted without loss; but that £178 of the adverse balance is due to loss on the supply of current. This is not, it seems, the result of any defect in the method of generating it, but of the adoption of the "scale system" of annual charges per lamp. The Directors frankly acknowledge that this system is altogether unsatisfactory; and they bring figures to support their statement. They say: "The current delivered to consumers for the quarter from Oct. 1 to Dec. 31, 1894, was 19,813 units; and the current revenue for the same period, £179 8s. 2d. The 10 customers on meter used 1303 units, and paid £38 0s. 1d., or 7d. per unit. The customers 'on scale' used 18,510 units, and paid £141 8s. 1d., or 1⅛d. per unit. The revenue from the latter item, at 7d. per unit, would have been £539 17s. 6d. The scale system has been a serious mistake from the outset, and must be abandoned forthwith." The Directors go on to state that "the high price of meters, taken in conjunction with the Company's inadequate resources, has hitherto been *the* difficulty in adopting the meter system;" but they offer the consolation that, a new and cheap meter having recently been invented, every consumer can now be supplied by measure, at a comparatively small capital outlay. Then, as our readers are aware, there has been trouble with the residents near the generating station. The plant was located in a position unsuitable for the nature of the operations carried on; and the result was naturally a prosecution, which led to a conviction for nuisance. This has compelled the Directors to "face the alternative," as they put it, of removal to a non-residential site, and has "compelled the discontinuance of service of light since March 31 until the removal is accomplished." This will entail an expenditure of £1800; and as the ordinary share capital has been stationary for upwards of a year, the Directors have no option but to offer for subscription £2000 of 5 per cent. cumulative preference shares (£1). These are to be first offered to the existing shareholders; and, if they are not quickly snapped up, the general public are to be afforded an opportunity of looking in. Supposing the additional capital to be promptly subscribed, the Directors hope to be in a position to resume service by the 1st of July. So much for the report. We will not attempt to deal at any length with the accounts, which have been certified by Mr. J. Duff, of Halifax. This, however, may be said, that

the Company's share capital is £15,000, of which £6663 has been paid up; and the mortgage debentures are valued at £2965, while accounts to the total of £1883 are owing. Mr. Duff says no depreciation has been allowed. He has, however, prepared a special report on the Company's affairs, which was read at the meeting; and, from what we learn, the book-keeping is not what it might be. With regard to the new capital required, it will be surprising to us if either the shareholders or the public show great alacrity in applying for it, notwithstanding that "Mr. A. H. Preece, of London," has made a report in which he says he considers that the Company have good prospects, and that, with the new station, there will not be any increase in working cost. The Company's Electrical Engineers are Messrs. Andrews and Preece, Limited; and, judging from certain newspaper correspondence, the relations between them and the Company are not just now very cordial. Mr. T. Preece says, in regard to the proposed issue of new capital: "I have seen Mr. A. H. Preece's report, also the Directors' report for 1894, with respect to which I must express my astonishment. In my opinion, it will be a very difficult matter indeed to get new capital on the strength of such admissions and mistakes as pointed out in the report; neither do I see how it will benefit the Company to point out to the consumers that they have been paying 1¼d. per unit for their current, but that, if they had only paid nearly five times as much for the supply, the revenue of the Company would have been better."

The advertised appointment of Chief Electrical Engineer to the Vestry of Hampstead attracted 58 applicants. Of these six were selected by the Lighting Committee, and invited to attend last Thursday's meeting. Before the voting commenced, the Chairman (Mr. H. Harben) announced that apparently none of these gentlemen had been personally interviewed by the Committee—a most unusual course, he thought; and, under these peculiar circumstances, he would allow members to address more searching questions to the candidates, and strangers would have to withdraw. Mr. G. H. Cottam, Chief Electrical Engineer to the Corporation of Hanley, secured the appointment, which is terminable by one month's notice from either side; and the officer must devote his whole time to the Vestry. Mr. Hackworth asked him whether he was willing to sign a declaration that he did not expect any pension on leaving; but, on the Chairman pointing out that this clause did not appear in the advertisement, the question was not pressed. Later in the evening, Mr. Johnson called upon the Chairman of the Lighting Committee to furnish the Vestry with certain figures as to the mileage cost of the cables, &c., according to a question of which notice had been given; but the statement elicited was of so incomplete and rambling a nature that it was decided to postpone these particulars till the next meeting. The Comptroller of the London County Council has addressed a letter to the Vestry on the subject of the term of years over which the repayment of loans for electric lighting purposes should be spread. He states that, having lately received a letter from the Treasury on the question, the Council were now in a position to sanction and advance such loans, either: (1) For land, buildings, culverts, bare copper mains, and royalty licences relating to such purposes, 50 years; for all other purposes, 20 years. (2) A mean period of 42 years for all loans for the initial cost of an electric lighting undertaking, on the understanding that, if any works fail to be renewed during the currency of the mean period, the cost of renewal shall constitute a maintenance charge, and shall not be made the subject of a fresh loan.

Some, at least, of the ratepayers of St. Pancras are not altogether convinced by the plausible report presented by the Electricity Committee. At a meeting of the Ratepayers' Association last Friday, Mr. H. C. Eaton, the Honorary Secretary, confessed his scepticism of the printed accounts, and said he could not see how the stated profits had been realized. Figures were easily "worked," and details might be overlooked; and he was suspicious that the profits had been approximated, and that too much attention had been paid to what might in future be realized. In reply, Mr. Hodgkinson maintained that the accounts were made out in accordance with the requirements of the Board of Trade, and were a simple statement of what had been accomplished in the year. He was confident that Mr. Bellamy, by whom the statement was drawn up, could be depended upon for the strictest accuracy; and he thought the report a fair one. Mr. Wright asked whether it was not a fact that they were themselves their own best customers. Mr. Hodgkinson admitted that this was so; but he pointed out that the cost for public lighting was now 5d. per unit, and the Lighting Committee provided the carbons, &c. Mr. Maplestone said this meant that the Lighting Committee were subsidizing the Electricity Committee—an explanation throwing an instructive side-light on the gentle art of profit-making as practised by the St. Pancras Vestry.

Suggested Purchase of the Blyth Water-Works.—The Blyth Town Council have appointed a Special Committee to obtain information as to the desirability of purchasing the local water-works.

The Capital Expenditure on New Gas-Works at Rochdale.—According to the recently-issued accounts of the Rochdale Corporation, up to the present about £40,000 has been spent on the extensions of the gas-works now in progress. Of this sum, £10,000 has been paid on account of the new holder, and £4500 for the tank. About £10,000 has been expended on the retort-house; £7700 for inclined retorts, with their foundations and settings; £1400 for a boundary wall; and £3100 for a high-level road. The results of the working of the department during the past year were noticed in the JOURNAL for the 30th ult.

The Board of Trade and the Price of Gas at Felixstowe.—The Board of Trade have informed the Parliamentary Agents of the Felixstowe and Walton District Board that they propose to proceed with the settlement of the local Gas Company's Provisional Order, and to fix the maximum price to be charged for gas at 5s. 3d. per 1000 cubic feet, with power to the Board of Trade to alter the maximum price, or to substitute a standard price with sliding-scale of price and dividend after the expiration of three years. The Board do not consider that the case was one in which they could at present sanction a sliding-scale of price and dividend.

THE OPPOSITION TO THE LONDON WATER TRANSFER BILLS.

Among the numerous petitions presented against the two Water Transfer Bills of the London County Council to be considered by the Select Committee to-day—viz., the Lambeth and Southwark and Vauxhall Bills—is one by the New River Company. It states that the principal object of the eight Bills promoted by the Council is (1) to substantially depreciate the value of the London water undertakings, and (2) the acquisition of the undertakings for considerations based on estimates of the works when so depreciated, but without the Arbitrator having the right to consider the elements which led to the depreciation. The proposed acquisition of the undertakings, under the powers contained in eight separate Bills, would, they say, have the effect of enabling the Council, when they become owners of the undertaking of any one of the Companies, to enter into competition, in overlapping areas, with Companies having power to supply within such areas, and of whose water undertaking the Council had not become owners; thereby depreciating the value of such undertaking with a view to subsequently purchasing it. They urge that the Bills propose to import wholly new principles into the methods of determining the value of properties taken compulsorily for public purposes. They point out that general law has hitherto settled the principles that should be applied in such cases; and they submit that it is inexpedient by Private Bill legislation, to alter or set aside the public law, and introduce, and make applicable to a particular case, new laws and new principles. They also submit that it is unreasonable that a water undertaking should, as proposed in the Bills, be transferred from the owning Company before the consideration has been ascertained.

The Hampstead Vestry have decided to petition against the New River and West Middlesex Transfer Bills; and at their meeting last Thursday they drew up a formidable list of "points" to be raised by their Solicitor in Committee. These included the following: All mains to be relaid at a depth of 3 feet from the surface; connections to be laid up to the consumer's house, and to be maintained at the sole cost of the Water Authority; all connections and disconnections of supply to be made free of charge to consumer; constant supply to be peremptory; a proportionate rebate to be made to consumers when the supply fails through the severity of the weather; consumers rated at £50 or upwards to have the option of paying either by meter or according to rateable value; no extra charges to be made for supplies for gardens, conservatories, extra baths, or closets, where included in the rateable value, and not used for trade purposes; the charges for watering streets and flushing sewers and drains to be revised, and these charges to be assimilated, as far as possible, throughout the Metropolis; and penalties to be imposed on the Water Authority for defaults by them.

In connection with the proposal to effect a combination of the Kent County Council and the Local Authorities in West Kent, to which reference was made last week, a discussion took place at the meeting of the Bromley District Council last Friday. Sir J. Farnaby Lennard, Chairman of the Kent County Council presided; and he pointed out that, if the London County Council succeeded in getting their Bills passed, they would first deliver the necessary supply to the Metropolis, and then allow the extra-Metropolitan area—in which were situated such places as Bromley, Beckenham, Dartford, Sevenoaks, Erith, and Bexley—what surplus there was left. He regarded the proposals of the Council as absolutely ruinous to the West Kent district; and he did not think in equity it was right that the West Kent area should be robbed of the splendid supply of water it now possessed. In order to succeed in their opposition to the Council's policy of absorption, it was necessary that some counter-scheme should be brought forward. The Clerk of the Kent County Council, after an interview with the authorities in London, was prepared to recommend his Council to take the initiative in opposing the Bills, provided they were indemnified in the matter of costs. It would, of course, be unfair to ask such places as Ashford, Folkestone, and Dover, and the eastern part of the county, to contribute towards the cost of a scheme which would affect the western part entirely; and he consequently thought that it would be best to institute a Water Trust on a representative basis, so as to include the various Authorities in West Kent, and either to delegate the powers of management to local Committees, or to control the whole water supply of West Kent by one central Board—preferably the Kent County Council. This really meant buying for their own use the undertaking of the Kent Water Company; and if they were successful in this, they would be able to reduce the price of water, or apply the profits in reduction of other rates. He proposed that Messrs. C. E. Baker and Co., Parliamentary Agents, be instructed in accordance with the lines he had just indicated. The proposition was unanimously agreed to. A report on the scheme has been prepared by Messrs. Williams, Hennell, and G. Chatterton, MM.Inst.C.E., who express the opinion that the Local Authorities of Kent should, if possible, acquire for themselves all that part of the undertaking of the Kent Water Company which is situated in, and supplies, their districts; and they think that, if the purchase could be made on reasonable terms, it would be to their advantage to carry it out. They suggest that the management of the acquired works should be undertaken by a Joint Water Board, to be elected by all the authorities concerned.

IPSWICH CORPORATION WATER SUPPLY.

Last Wednesday, the Water Committee of the Ipswich Town Council submitted a report on the working for the year ending March 31 last. A reference to the extension and improvement of the distribution system in the Stoke, California, and St. John's districts, was followed by the statement that the amount of water pumped into the reservoirs in the second half of the year was calculated at 123,817,000 gallons. As to the supply during the winter, the emergency supply and the repair of burst mains in consequence of the frost cost £347. Dealing with the question of charges for water supplied for other than domestic purposes, the Committee had thought it desirable, in the case of water taken through a meter for trade purposes where no domestic supply was afforded off the same service, to abolish the minimum charge;

and only the water registered as actually passing through the meter was now paid for in such cases. The Committee recommended that the remainder of the investment in Consols (£3241), representing the balance of the £10,000 of surplus capital raised when the undertaking was purchased, should be sold, to meet in part the expenditure already incurred on capital account.

Mr. D. Ford Goddard, the Chairman of the Committee, in moving the adoption of the report, alluded to the new pumping-engine which was started last year, and which, now that certain difficulties had been overcome, was working satisfactorily. Referring to the balance-sheet, he said the profit of the year showed a decrease of something over £600, which was accounted for mainly in the item for maintenance of works, which during the year amounted to £1974, as against £1052 in the previous year; showing a difference of over £900. It had been necessary to lay a large number of mains, many taking the place of older ones; and the Committee had to credit the renewal account with some portion of this cost. Respecting the increase of expense necessitated by the employment of labour in pipe-laying, he said the Council would readily understand the amount of labour needed in laying no less than 10,416 9-inch pipes, and a large number of 6-inch and 3-inch ones. Since the Corporation had had the control of the water-works, six miles of new and large mains had been put down. He pointed out that a considerable decrease had taken place in the item of consumption of coals; the expenditure being £200 less than in the previous year.

Alderman Turner seconded the motion.

Mr. Cattermole remarked that the public were particularly anxious to know whether the Committee had or had not paid their way. The public did not yet seem to grasp the fact that, for the purchase of these works, only £2100 had come from the rates; nor was it likely that any more would need to be drawn from that source.

Mr. Jervis expressed the opinion that the account was not so satisfactory as it should be. The water-rental for the year had only increased by about £140. Building had been going on in various parts of the town, and extensions of the mains had been made; and the Committee were utterly unable to state the reason for the smallness of the increase.

Mr. Goddard, in replying to the discussion, pointed out that the Committee were paying £1500 per year out of revenue for redemption of capital. The charges for water had not been increased; the only matter on which it might be said there had been increase was where meters had been brought into use, and in these cases the opportunity had been given to go back to a payment equal to 5 per cent. on the gross value.

The motion was then adopted.

Darwen Corporation Gas-Works Finances.—At the meeting of the Darwen Town Council on the 6th inst., Mr. Davies, the Chairman of the Gas Committee, presented his statement as to the working of the Gas Department during the financial year ended the 25th of March last. He said he was glad to be able to give a favourable account of the operations at the gas-works. After pointing out that the previous year's balance-sheet showed a net loss of £157, Mr. Davies proceeded to say that they had in the past twelve months carbonized 14,149 tons of coal and cannel, as against 13,019 tons in 1893-4; and the cost was only £7352, as compared with £8982 in the preceding year. This arose largely from the quantity of cannel used; and it was satisfactory to the Committee to know that they had been able to keep the illuminating power up to the average. The quantity of gas consumed was 134 million cubic feet, as against 124 millions; and it was noticeable that the largest increase in consumption had been among the shopkeepers. The total increase in the revenue from gas was £2437; and there was a gross profit of £12,952 on the year's working. This had been obtained although there had been an additional payment of £200 in rates. The sum of £9222 had been taken for interest and for the sinking fund; and the net balance was £3729. This was a result which, in the speaker's opinion, reflected the greatest credit upon the management. He added that the increase in the price of gas had yielded £1700; and coal had been purchased on more favourable terms. He concluded by intimating that the price of gas might be reduced about July.

Sales of Shares and Stocks.—Messrs. Coombes, of Ryde, sold by auction on the 1st inst., a number of shares in public companies, by order of the Executors of the late Mr. George Garnett; and the results were most successful. Original £5 shares in the *Shanklin Gas Company* realized £9 7s. 6d. and £9 12s. 6d.; and new ordinary shares of the same nominal value produced £6 15s. and £6 17s. Original £20 shares in the *Ventnor Gas and Water Company* sold at £24 10s.; and £20 additional capital shares, at £17. Some £25 ordinary shares in the *Gosport Gas Company* fetched £41 each; £25 preference shares, £28 5s.; and similar shares, on which £20 had been paid, £22 10s. £50 "B" shares in the *Portsea Island Gas Company* were disposed of at £136; £50 "C" shares, at £122; and £7 5s. 10d. of stock at £8 15s. Original £10 shares in the *Portsmouth Water-Works Company* yielded £29 5s.; £5 new (1868) shares found purchasers at from £14 to £14 15s. per share; £5 new ordinary capital shares (1879 series) realized £9 15s.; and similar shares of the 1883 series fetched £7 17s. 6d.——On the 7th inst., Mr. Alfred Richards, also by order of the Executors of the late Mr. George Garnett, disposed of the following stocks and shares, at the Mart, Tokenhouse Yard, E.C.: £40 of "A" capital stock in the *Barnet District Gas and Water Company* was sold at the rate of £222 10s. per cent.; £460 of "C" capital stock, at £212 10s. per cent.; £90 of "D" capital water stock, at £160 per cent.; and 3 per cent. mortgage bonds (one £800 and two £200), at £103 per cent. Twenty £10 fully-paid shares in the *Gas-Meter Company, Limited*, realized £22 10s. each; four 5 per cent. debenture bonds of £25 each in *Edward Cockey and Sons, Limited*, were sold at the rate of £76 per cent.; and ten £10 fully-paid ordinary shares in the same concern fetched £6 5s. apiece. ——Mr. J. J. Cunnah, of Chester, recently sold £144 of new ordinary stock in the *Chester Water-Works Company*; and it realized £220.——A few £10 shares in the *Boston Gas Company* have been sold locally at £18 7s. 6d. each.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Perth Gas Commission have begun to tackle in earnest the subject of the removal of the gas-works to a new site. They had before them this week a report upon it by Mr. T. Whimster, their Engineer and Manager, which, like all his work, is characterized by the great care and thoroughness with which he has gone into the matter. Mr. Whimster recalls that when, in 1872, the two then existing Gas Companies were taken over by the Corporation, it was decided to close the Blackfriars Works, and to dispose of them, and to enlarge the works in Canal Street so as to make them nearly equal to the capabilities of the two works. At that time, the gasholder capacity was 104,000 cubic feet; consisting of two holders of 16,000 cubic feet each, and one of 72,000 cubic feet. The two small holders were removed; and in their stead one holder of 127,000 cubic feet capacity was constructed. At the same time, four new purifiers, each 10 feet square, were added; and the purifying plant was capable of dealing with double the output, which was then about 40 million cubic feet a year. Fifteen years later, the output had increased to 70 million cubic feet; and the productive limit of the works had been reached. A general enlargement was effected in 1888 and 1889. This consisted of converting the retort-settings from threes to fives; the construction of a 14-inch horizontal wall condenser; the erection of four tower washers; and the replacing of the purifiers by new ones 20 ft. by 14 ft. At that time it was foreseen that it would, sooner or later, be necessary to transfer the works to a new site; the space being limited, and incapable of further extension. There was then a daily consumption of 500,000 cubic feet; and the storage accommodation being only 199,000 cubic feet, a new holder of 600,000 cubic feet capacity was constructed at the Shore. One of the old holders was removed; and its site was utilized for the construction of two new purifiers, each 20 feet square, and the formation of a coke yard. Now again the works are in use up to their full capacity; the reserve in the retort-house last winter having been only ten retorts. The proposed site for the new works is known as the Sand Island, at the Shore. Mr. Whimster estimates that, allowing £2000 for the cost of the site and £1000 for parliamentary expenses, the probable charge for removing the works would amount to £18,659. For the present site, he estimates that they would receive £4500, which would leave the net cost at £14,159. But along with the transfer of the works, additions would require to be made, for which he estimates as follows: New gasholder, £7500; purifiers, washer, and station meter, £1050; and contingencies, £2290—making a total outlay of £25,000. Some tables prepared by Mr. Wright, the Convener of the Works Committee, are appended to Mr. Whimster's report. These show that, in the year ending April 30, 1873, the quantity of gas delivered was 40,948,500 cubic feet, the price was 5s. 10d. per 1000 feet, and the unaccounted-for gas delivered was 13·19 per cent.; while in the year just closed, the quantity of gas delivered was 105,385,000 cubic feet, and the price was 3s. 9d. per 1000 cubic feet. The estimated annual saving by the transfer, on account of railway and sea connections, &c., is stated at £954; and this sum would be sufficient to pay 3 per cent. on £25,000, and would leave £204 a year towards a sinking fund. The Commissioners, after considering the report in committee, resolved to get a report from a neutral engineer, and to ask Mr. Whimster to further report on the subject. There can be no objection to the Commissioners displaying caution on so large a subject, and seeking the best advice upon it. One thing they might do with advantage, and that is take a look at what has been done in Dunfermline, which is the latest instance in these parts of a transfer of works, and where everything was satisfactorily accomplished.

The story is being circulated that the Perth Gas Commissioners were so satisfied with the coal from the North of England which they were obliged to purchase during the strike of coalminers in Scotland last year, that they have this year given a large order for coal to a North of England firm. Coal can be carried from the Tyne or Durham ports to Perth by sea, and delivered at as low a cost as Scotch coal can be delivered, either by rail or sea. There is also this further explanation of the Commissioners being able to use English coal producing 16-candle gas—that they use the Peebles process for enriching their gas by oil. This is a most convincing proof of the great value of the process to gas managers; as it enables them to go into an unrestricted market, and buy any sort of coal they please.

A deputation consisting of five members of the Leeds Town Council were in Glasgow on Monday last for the purpose of seeing if anything was to be learned from the municipal arrangements of the city, which, it is freely acknowledged, are more advanced and enlightened than in any other large city. Among other sights they were shown, were the Dawsholm Gas-Works. These are about as perfect as it is possible for gas-works to be. The visitors were greatly pleased with the retort-house arrangements; and the large gasholder was a special object of interest to them.

Provost Vallentine, of Brechin, on Thursday of this week moved, at a Town Council meeting, as he intimated a week or two ago, that a remit be made to the Finance Committee to consider and report on the subject of the Council acquiring the undertaking of the Brechin Gas Company. He thought that the present was a fitting time for considering the subject, for he had reason to believe that the Company would be inclined to deal with them, as they had not been in a very prosperous condition for the last three years. A member pointed out that they must appoint a Committee with full powers before the Directors of the Company would deal with them; but the Provost thought there would be no harm in the Finance Committee considering the subject. The motion was accordingly passed. The Committee will, I suppose, submit a general report; and upon the terms of it will depend whether the Council will then seek to negotiate with the Directors of the Company.

From Dundee, it is reported that the cost of the new gas offices which have been erected in Commercial Street of that city, has been £14,639, including £5000 for the purchase of the site. The gas-rental for the year just ended is reported to have amounted to £72,526, which, with the price of gas unchanged, is £2624 more than in the preceding year. The Gas Committee of the Corporation on Tuesday

night fixed their coal contracts for the current year; the quantity required being 57,000 tons, and the prices ranging from 9s. 9d. to 14s. 6d. per ton. The prices are, on an average, 6d. per ton less than last year. The contractors are practically the same as they have been. The Gas Committee had under consideration a proposal to extinguish the electric arc lamps on the street at half-past eleven, and to employ gas-lamps for the remainder of the night. They resolved to recommend this course, their reason being the cost of the electric lamps. It does seem folly to lavish light, at a high cost, on deserted streets; but it is doubtful if very much will be saved by the substitution of a dual system of street lighting. Seeing that there are only four arc lamps in the street, they would not be missed, although they were thrown out altogether and gas lighting on an increased scale were reverted to; and the saving would be great. But, of course, such a step would have the air of a retrograde movement; and it can scarcely be entertained. The proposal to restrict the use of the electric light, however, shows the folly of rushing that form of lighting upon a community. It is significant, with regard to the use of electricity for street lighting in Scotland, that there have been no proposals anywhere for an increase of the original installation.

A prospectus is issued containing a proposal to raise additional capital for the Rosewell Gas Coal Company, Limited, Fifeshire. The capital at present is £25,000; and the idea is to increase it to £40,000, by the creation of 6 per cent. preference shares to the amount of £15,000. The capital is mostly intended to be applied in the development of a house and steam coal field which was acquired in 1890 and added to the cannel coal field.

Sulphate of ammonia has risen again. On Tuesday it advanced from £9 15s. prompt to £10 5s., and on Friday to £10 10s. per ton, for June-December delivery.

The Edinburgh Town Council, acting on the advice of Professor Kennedy, threaten not to allow change-over switches, as they are dangerous. This, if resolved upon, means that parties who possess private electric lighting installations will not be able to take in the public supply and treat it as a stand-by.

It is proposed to retain the water-rates in the Glasgow area of supply as they are this year—the domestic rate at 6d. per pound in the city, and 10d. per pound outside the city, and the public rate at 1d. per pound.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May* 11.

Sulphate of Ammonia.—The continued decline, which for weeks past has had to be recorded, has come to an end; and there has been a sharp recovery in values. The low level reached had become attractive to consumers; and the serious inquiry on their part had, a week ago, begun to steady the market. The serenity of "bear" operators once disturbed, alarm followed; and just as the decline was brought about largely by persistent "bearing," so the advance must be mainly attributed to anxiety on the part of these operators to cover their sales, since the bulk of the buying has been done on their account. Consumers have not altogether followed the advance. They seemed rather inclined to wait events; but, on the other hand, makers, having availed of the advance to relieve themselves of a portion of their stock, feel comfortable about the future, and are disposed to look on for the present.

There has been a good demand f.o.b. Liverpool, where up to £10 5s. has been paid for prompt stuff. There have been a few transactions f.o.b. Hull; and the closing value there is about £10 to £10 2s. 6d. per ton. A considerable business has been done in Scotland for delivery over the autumn months at up to £10 12s. 6d. f.o.b.; and spot value f.o.b. Leith is now £10 2s. 6d. to £10 5s. per ton.

LONDON, *May* 11.

Tar Products.—Benzols continue to show weakness; and buyers appear to be holding off in expectation of still lower prices. Carbolic acid and cresylic acid have still further advanced, and crystals in conjunction with them. The probabilities are in favour of very considerably higher values; and there are on the market many anxious buyers both for prompt and forward. The stock, however, appears to be small; and buyers seem unable to cover anything like their requirements. Creosote is weaker; the Scotch sellers being especially weak—in fact, values there have already approached to within a shade of the lowest prices which were prevalent some time ago. Pitch is firm; and business has been reported at prices considerably higher than those of last week. There seems little doubt but that pitch will maintain its position, and probably improve it. Prices are as follows: Tar, 18s. to 22s. Pitch, 34s. 6d. Benzols, 90's and 50's, 11½d. Solvent naphtha, 1s. Toluol, 1s. 1d. Crude, 30 per cent., naphtha, 4d. Creosote, liquid, 1½d.; ordinary, 1d.; salts, 20s. Cresylic acid, white, 1s. 1½d.; brown, 11d. Carbolic acid, 60's, 1s. 10d. Anthracene, "A," 1s. 1d.; "B," 10d.

Sulphate of Ammonia.—The extraordinary depression which reduced sulphate to a price not hitherto touched, has given rise to a speedy spurt; and prices have jumped already to £10 2s. 6d. to £10 5s., with plenty of buyers, and every likelihood of a further improvement. Gas liquor is quoted at 7s. 6d. to 8s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Although one of the most important gas-coal contracts in the district (that for the Manchester Corporation) is not yet settled, and there is necessarily a good deal of uncertainty as to the prices at which tenders will be accepted, the general belief is that they will be very low; and certainly, if what I hear is correct—that in one or two cases gas tenders have been based upon a determination not to be cut out by any other competition—the result of this may be tolerably well imagined. One or two smaller contracts have been settled; and the prices at which these have been taken are low enough—representing in one instance barely 7s. per ton at the pit mouth, for partially-screened Arley gas coal, and 1s. under this figure for Arley gas nuts, which is quite 1s. 6d. under last year's prices. With regard to the other important contracts—those for locomotive fuel, which are usually given out about this time of the year—I understand that a portion of these have been settled on the basis of 6d. per ton reduction upon last year's rates, representing about 6s. 3d. per ton for good locomotive fuel at the pit mouth. But whether this figure will be maintained all through, seems to be doubtful in some well-informed quarters. So far as the better qualities of round coal, suitable for house-fire purposes, are concerned, these are necessarily just at the present time in the very lowest possible demand; and to avoid further accumulations of stocks—which in most cases are already heavy—pits are getting on to less time. Common round coals for steam and forge purposes are also in very indifferent request and plentiful in the market, with very low prices ruling for both inland sales and for shipment. At the pit mouth, best Wigan Arley coals are still quoted 10s. to 10s. 6d. per ton; Pemberton four-feet and seconds Arley, 8s. 6d. to 9s.; and common round coals, from 6s. 6d. to 7s. 6d. per ton. Steam coal is readily obtainable at 7s. 6d. to 8s. delivered at the ports on the Mersey. Actual selling prices in the open market are, however, very irregular; and are a good deal governed by the character of the business offering, and the competition from other quarters. Engine fuel is in fairly good demand; and for the most part colliery proprietors have no difficulty in disposing of their present restricted output. Supplies are, however, ample; and at some of the pits there are still considerable stocks. This necessarily acts as a check upon any upward movement in prices, which remain comparatively low. Common slack is obtainable at from 3s. to 4s., and better qualities at 4s. 6d. to 5s. per ton at the pit.

Northern Coal Trade.—The coal trade is rather brisker in the steam-coal branch; but this is more than compensated for by the falling off in the home consumption of gas coals. The Baltic ports are now generally open; and, in consequence, the volume of shipments is very much increased, with a tendency towards steadier prices, especially for steam coals. For best Northumbrian steam, 8s. 9d. to 9s. per ton f.o.b. is now the current price; while for small steam, the rate varies from 3s. 6d. to 4s. per ton. There is a little better demand for manufacturing coals, as some of the factories are rather better occupied. In regard to gas coals, more of the large contracts for the year beginning with July have been placed, and that to an extent that must define very largely the price of gas coals for some time. These contracts have all been entered into at a price that is much lower than those they will replace. Allowing the current rates for freight, the prices range from about 6s. 1d. to 6s. 6d. per ton f.o.b., so that the gas companies will have a considerable gain in the new contracts. There is a larger demand for smithy coal for export. Coke is a little steadier, owing to the better prospects in the iron trade, and the increased demand for pig iron. For best Durham coke for export, the price is from 12s. 6d. to 13s. 6d. per ton f.o.b. Gas coke is in rather more limited supply; but the price is not affected, and stocks are diminishing owing to reduced production.

Scotch Coal Trade.—The Scotch coal trade continues depressed. Splint coal is very plentiful, and not in much demand. Steam coal is so little inquired after that full time cannot be worked in the pits. Ell is the only variety which is moving off at all freely; and prices for it are keeping firm. While trade is in this position, coalowners are not at all willing to enter into forward contracts at present prices, though buyers would be glad that they should. The prices quoted are: Main, 6s. per ton f.o.b. Glasgow (easy); ell, 6s. 9d. to 7s.; splint, 6s. 6d.; and steam, 7s. 6d. to 7s. 9d. The shipments for the week amounted to 142,041 tons—a decrease of 9446 tons upon the quantity in the preceding week, and of 28,615 tons upon the corresponding week of last year. For the year to date, the total shipments have amounted to 2,015,511 tons—a decrease of 425,354 tons as compared with the same period of last year.

The Nonpareil Automatic Gas-Meter Company, Limited, has been registered, with a capital of £1200, in £10 shares, to acquire certain patents relating to improvements in automatic gas-meters, and to develop and turn them to account. The Directors are Mr. J. P. Bark, Mr. C. G. Beechey, Mr. C. Pearson, and Mr. J. R. Roberts. No qualification is specified. The registered office is in Liverpool.

Tapping the Vyrnwy Aqueduct.—A Local Government inquiry has been held at Cholmondeley as to an application by the Nantwich Rural District Council for permission to borrow money to carry out works of water supply in the neighbourhood of Cholmondeley. It was explained that the cost of the work would be £1500; and the length of the district in which it would be necessary to lay mains, &c., was about five miles. The Engineer (Mr. Davenport) said the supply would be obtained from the Vyrnwy aqueduct.

Increased Consumption of Water at Manchester.—Mr. George Hill, the Water Engineer of the Manchester Corporation, in a report to his Committee, says there is considerable waste or an unnecessary use of water taking place at the present time. In four days last week—from Tuesday to Friday—there was an increase in the consumption compared with last year of over 4½ million gallons per day. Mr. Hill goes on to say: It is obvious that, if this increase continues for any length of time, the Water-Works Committee will be placed in a very difficult position in regard to the supply of a good quality of water. I must remind you that, although 10 million gallons of water per day can be brought from Thirlmere, it is necessary to carry out some extensive re-arrangements in the piping of the city in order to satisfactorily distribute the same, as until we had experienced the effect of the pressure of the additional supply from Thirlmere in the mains, we could not tell what alterations would be required. About one-half of this water (which is all I anticipated) has been already provided for. But it will be six or eight months before the remainder can be dealt with, as upwards of two miles of mains have yet to be laid, and considerable alterations made in the present system of distribution, before the arrangements for dealing with the full additional supply of water from Thirlmere can be completed in the way contemplated.

The Local Government Board and the Worcester Corporation.—The Local Government Board have assented to the Worcester Corporation borrowing £1076 for the high-level water supply works; the loan to be repaid in 28 years. The letter conveying the sanction, contains the following paragraph: "The Board cannot but regard the absence of any proper explanation of the excess of the cost of the works over the original estimate, and the system upon which the works were carried out as extremely unsatisfactory; and it is only in view of the assurances given to the Inspector at the inquiry that they have felt justified in sanctioning the loan."

Glasgow Gas and Electric Lighting Revenue.—Up to April 24 the total gas-rental paid into the Treasurer's Department of the Glasgow Corporation from the beginning of the financial year (June 1, 1894), amounted to £333,790; whereas at the corresponding date last year the collection amounted to only £318,091; so that there was an increase over a period of nearly eleven months amounting to £15,699. The amount collected in the shape of electric lighting rental up to the same date was £15,528, as compared with £13,364 over the corresponding portion of the preceding financial year. In this branch of the lighting department, there was also an increased revenue, which amounted to £2164.

Improvement of the Guildford Water Supply.—Colonel Coke has held an inquiry at Guildford as to the proposal of the Corporation to borrow £2250 for the purpose of improving the town water-works. Some short time ago, the Council purchased the borough mills; and they now intend to make use of the water power there to assist the water supply of the town. The town is dependent on a well situated within a short distance of the mills; and the water is pumped partially into reservoirs and partially direct into the mains. Three powers are used: One of the wheels in the mill, a gas-engine, and a steam-engine. The Consulting Water Engineer to the Corporation (Mr. A. F. Phillips) proposes to put in pumps and wheels at the mills, so that practically the whole of the pumping may be done by water power.

Lincoln Corporation Gas Supply.—At the monthly meeting of the Lincoln City Council last Tuesday, the usual statements were submitted as to the working of the Gas Department during the year ending March 25 last. Alderman Page, in moving the adoption of the Gas Committee's minutes, said the Council would see that the accounts for the past year had been presented by their Manager (Mr. J. Carter). As to the income, the amount received for gas was £24,835, against £23,146 last year—an increase of £1689. He reminded the members that for the preceding year about a third of the amount received was at the rate of 2s. 6d. per 1000 cubic feet, as compared with 2s. 4d. for the whole of the year just closed. So far as meter-rents were concerned, it would be recollected that the Council had reduced the rent by one-half, and the £1200 received before the reduction had been reduced in 1895 to £607. An important source of income was the residuals; and in the item of coke there was a marked similarity. Although they had had more coke, they had had to sell it at a less price; and the figures were £5035, as against £5032. For ammoniacal liquor, the receipts were £2979—an excess on the previous year of £482. The result was that the receipts for 1895 were £33,835, against £31,550—a total increase of £2283. Regarding expenditure, the result was fairly satisfactory. The coal bill was lower by £1318; £56 less had been spent for purifying materials, owing to the market price being lower. Rates and taxes had diminished by £200; a proportion of income-tax having been returned. The total decrease in expenditure was thus £1585; but there had been some increases. Salaries had been increased by £24; wages, by £385; and repairs, by £262. Indealing with repairs, they had to spend a certain amount of money in what were not strictly repairs but in the extension of mains; and they had charged that to revenue and not to capital, which brought up the total amount of increase in repairs to £417, the figures being £1238 against £831. Therefore although they had saved £1585, the expenses had increased by £1088, which left a net balance of £497. The balance for the year had increased by £2283; and with the saving in expenditure, the result was that they were £2780 better off than last year. The profits with which the Corporation had to deal amounted to £11,456. From this had to be paid interest on the stock £5994; they had to pay to the sinking fund £1973; and there was a small expenditure for bank interest, depreciation of cooking-stoves, &c., of £254—making a total of £8221, and leaving a net balance available to be dealt with by the Corporation of £3235. In addition to this, £1113 was brought forward from the profit and loss account last year; and this increased the sum at their disposal to £4348. They had had some discussion in Committee, and although no formal resolution had been adopted, they were proposing to deal with the sum in this way: They had a reserve fund accumulated from interest in the preceding years of £17,900; and they proposed to increase that to a sum they set before them as a minimum reserve and as a sufficient maximum—viz., £20,000, which would absorb £2100. In addition, the Corporation had given the Committee authority to spend money on a plant for the manufacture of sulphate of ammonia; and for that £1000 would be set aside. This would enable them to carry forward £1248, which was a sum in excess of that of the previous year. As to the consumers of gas, considerable concessions had already been made. The price of gas, which was 2s. 8d. when the Corporation took over the undertaking, had been reduced to 2s. 4d. They had also reduced the meter-rents by one-half; and unless the Council had a strong objection, they were proposing as from Michaelmas next to abolish the meter-rents altogether—a proceeding which would involve a loss of £300 during the current year and £600 a year in the future. But they felt warranted in making this concession for this reason—that of the £17,900 of the reserve fund, £12,000 was already invested in bank stock, and £2000 more would be invested very shortly; and they felt the reserve fund would not be required to be increased beyond £20,000. The interest on that fund would practically provide a fund to enable them to abolish the meter-rents; and he thought such a use of the fund was a very legitimate one. It was a fund which would prove useful with regard to income, and still be a sufficient and adequate reserve on a capital of £200,000. The increase in business proceeded at a very satisfactory rate. They had carbonized 2660 tons of coal more this year than last; and the make of gas had exceeded last year by 25,783,000 cubic feet. The motion was agreed to.

Lincoln Corporation Water Supply.—At the meeting of the Lincoln City Council last Tuesday, the Water Committee submitted a statement showing total receipts amounting to £9773 for the year ending March 25 last, as compared with £9464 for 1893-4.

The Price of Gas in the Outlying Districts of Manchester.—This subject was considered by the Withington District Council last week; and the discussion resulted in the passing of the following resolution: "That, having regard to the fact that the Manchester Gas Committee has shown that gas can be supplied in the city at 2s. per 1000 cubic feet, this Council is of opinion that the proposed reduced charge of 2s. 9d. per 1000 cubic feet, together with the continuance of meter-rents, now abolished in the city, is excessive; and that failing the Corporation making a further substantial reduction in the charge for gas supplied in the Withington district, this Council will have no alternative but to take into consideration the question of obtaining powers for supplying its district with gas, either in conjunction with other suburban authorities or otherwise, independently of the Manchester Corporation." They have also urged the District Councils of Cheadle, Levenshulme, Moss Side, and Stretford to make a similar representation to the Manchester Corporation.

The Payment of Water-Rates for Periods of Non-Supply.—It is stated that the Lambeth and Grand Junction Water Companies have each received a request from some 300 of their customers, asking that a proportionate part of the water-rate may be remitted for the period of non-supply during the past winter. The requisitions have been forwarded to the Companies by the Defence Committee, formed at the conference of water consumers lately held at Surbiton, at which it was decided that the Companies should be approached in the first place with a view to a pacific settlement. It is hinted in a local paper that, in the event of the Companies declining to give way, a test case will be brought before a Court of Law. The Wimbledon District Council have invited the neighbouring Local Authorities to co-operate with them in obtaining the opinion of Counsel as to the legal position of consumers in regard to the failure of the water supply. The Croydon Rural District Council have agreed to do so; but information has not reached us asto the decisions of the other Authorities.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1019.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	10 Apl.	10½	Alliance & Dublin 10 p. c.	10	21½–22½	+½	4 13 4
100,000	10	,,	7½	Do. 7 p. c.	10	14½–15½	+½	4 16 9
300,000	100	2 Jan.	5	Australian (Sydney) 5% Deb.	100	105–107	..	4 13 4
200,000	5	10 May	6½	Bombay, Limited	5	6¾–7*	+¼	4 12 10
40,000	5	,,	6½	Do. New	4	4¾–5¼*	+¼	4 19 2
380,000	Stck.	28 Feb.	11½	Brentford Consolidated	100	243–248	..	4 12 8
180,000	,,	,,	8½	Do. New	100	195–200	..	4 5 0
220,000	Stck.	14 Mar.	11	Brighton & Hove Original	100	220–225	..	4 17 9
888,500	Stck.	28 Feb.	5	Bristol	100	120–123	..	4 1 4
320,000	20	28 Mar.	11½	British	20	50½–51½	+½	4 7 3
50,000	10	14 Mar.	11½	Bromley, Ordinary 10 p. c.	10	21–22	..	5 4 7
51,510	10	,,	8½	Do. 7 p. c.	10	16–17	..	5 0 0
328,750	10	14 Nov.	2	Buenos Ayres (New) Limited	10	6½–6¾	..	2 19 3
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	100–103	..	5 16 7
150,000	20	28 Feb.	8½	Cagliari, Limited	20	26½–27½	..	6 0 0
550,000	Stck.	10 Apl.	13½	Commercial, Old Stock	100	283–288	..	4 13 9
165,000	,,	,,	10½	Do. New do.	100	212–217	..	4 16 9
160,762	,,	13 Dec.	4½	Do. 4½ p. c. Deb. do.	100	130–135	..	3 6 8
800,000	Stck.	13 Dec.	13	Continental Union, Limited.	100	250–255	..	5 1 11
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	205–210	..	4 15 3
535,000	Stck.	28 Feb.	5½	Crystal Palace Ord. 5 p. c. Stk	100	120–125	..	4 4 0
486,090	10	31 Jan.	11	European, Limited	10	24–25	..	4 8 0
351,060	10	,,	11	Do. Partly paid	10	17–18	..	4 11 9
5,646,590	Stck.	14 Feb.	12	Gaslight & Coke, A, Ordinary	100	267–272	..	4 8 3
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	105–110	..	3 12 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	275–280	..	3 11 5
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130–135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	197–202	..	3 14 3
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	185–190	..	3 13 8
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	275–280	..	3 11 5
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	163–168	..	3 11 5
1,061,150	,,	13 Dec.	4	Do. 4 p. c. Deb. Stk.	100	129–132	..	3 0 7
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	140–145	..	3 2 1
908,000	,,	,,	6	Do. 6 p. c. do.	100	188–192	..	3 2 6
3,800,000	Stck.	10 May	12	Imperial Continental	100	235–240*	+1	5 0 0
75,000	5	13 Dec.	6	Malta & Mediterranean, Ltd.	5	5¼–6¼	..	4 16 0
563,000	100	1 Apl.	5	Met.of Melbourne, 5 p.c. Deb.	100	110–112	..	4 9 3
541,920	20	14 Nov.	5	Monte Video, Limited	20	15½–16½	..	6 1 2
150,000	5	29 Nov.	8	Oriental, Limited	5	7–7½	..	5 6 8
60,000	5	28 Mar.	7	Ottoman, Limited	5	4½–5¼	..	6 13 4
166,870	10	14 Feb.	2	Para, Limited	10	1½–2½	..	8 0 0
420,000	100	2 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	102–106	..	5 13 2
500,000	100	1 Dec.	6	2nd Do.	100	102–107	..	5 12 1
150,000	10	26 Apl.	7	San Paulo, Limited	10	8¾–9¼	..	7 7 4
500,000	Stck.	14 Feb.	15½	South Metropolitan, A Stock	100	350–360	..	4 6 1
1,350,000	,,	,,	12	Do. B do.	100	293–298	..	4 0 6
290,000	,,	,,	13	Do. C do.	100	307–312	+2	4 3 4
775,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	100	167–172	..	2 18 2
60,000	Stck.	28 Feb.	11½	Tottenham & Edm'nton, "A"	100	230–235	..	4 17 10
				WATER COMPANIES.				
746,021	Stck.	28 Dec.	10½	Chelsea, Ordinary	100	276–281	–2	3 12 0
1,719,514	Stck.	10 Apl.	8	East London, Ordinary	100	212–217	..	3 13 9
654,740	,,	28 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	151–156	..	2 17 8
700,000	50	13 Dec.	8½	Grand Junction	50	107–111	–1	3 16 7
708,000	Stck.	14 Feb.	12	Kent	100	303–308	..	3 17 11
1,043,800	100	28 Dec.	9½	Lambeth, 10 p. c. max.	100	233–238	–3	3 19 10
406,200	100		7½	Do. 7½ p. c. max.	100	200–205	..	3 13 2
330,000	Stck.	28 Mar.	4	Do. 4 p. c. Deb. Stk.	100	136–140	..	2 17 2
500,000	100	14 Feb.	12½	New River, New Shares	100	355–365	–5	3 9 10
1,000,000	Stck.	31 Jan.	4	Do. 4 p. c. Deb. Stk.	100	140–143	..	2 15 11
902,300	Stck.	13 Dec.	6	S'thwk & V'xhall, 10 p.c. max.	100	143–148	–2	4 1 0
126,500	100	,,	6	Do. D 7½ p.c. do.	100	138–143	..	4 3 11
1,155,066	Stck.	13 Dec.	10	West Middlesex	100	267–272	..	3 13 7

*Ex div.

GWYNNE & BEALE'S
PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams:
"GWYNNEGRAM, LONDON."

Telephone No. 2698.

GWYNNE & CO.,

HYDRAULIC AND GAS ENGINEERS,

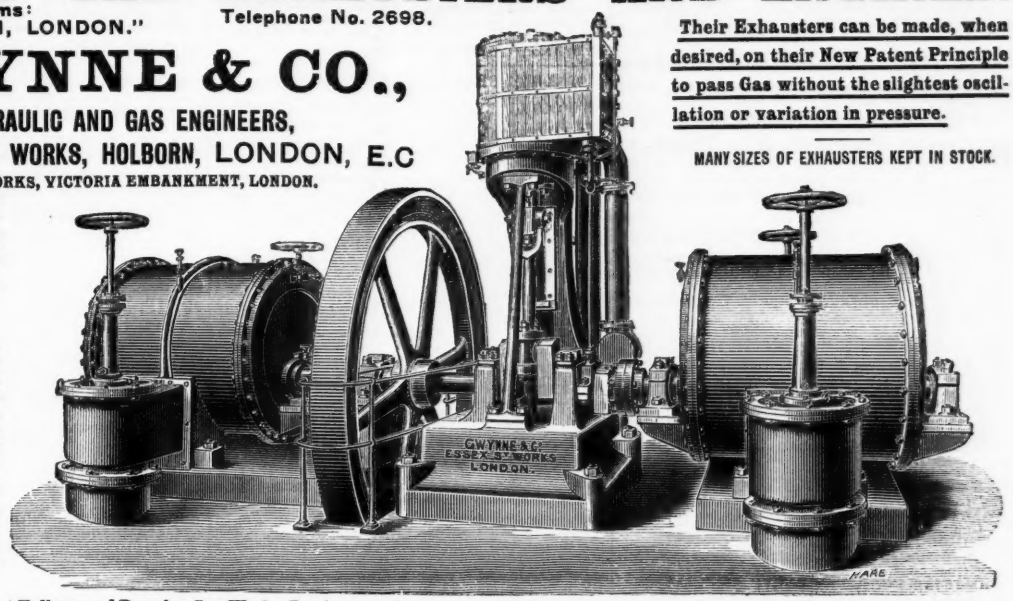
BROOKE STREET WORKS, HOLBORN, LONDON, E.C

Late ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON.

They have completed Exhausters to the extent of 32,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.



Their Exhausters can be made, when desired, on their New Patent Principle to pass Gas without the slightest oscillation or variation in pressure.

MANY SIZES OF EXHAUSTERS KEPT IN STOCK.

Exhausting Machinery at Fulham and Bromley Gas-Works, London—each set passing 400,000 cub. ft. per hour drawing 14 miles distant from Beckton.

Catalogues and Testimonials sent on application.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

JOHN WM. O'NEILL, Managing Director,
Palmerston Buildings, Old Broad Street, London, E.C.

ANDREW STEPHENSON, AGENT. All communications re Oxide to be addressed to Palmerston Buildings.

WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr In use in most Continental Gas-Works, and in more than 300 British Gas-Works.

ANDREW STEPHENSON,
182, GRESHAM HOUSE,
OLD BROAD STREET,
LONDON, E.C.

Telegrams: "Volcanism, London."

AMMONIACAL LIQUOR Wanted.

BROTHERTON AND CO., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS TAR Wanted.

BROTHERTON AND CO., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SPENT OXIDE Wanted.

BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BROTHERTON & CO.

Offices: Commercial Buildings, LEEDS. Correspondence invited.

JOHN RILEY & SONS, Chemical Manufacturers, Hapton, near Accrington, are MAKERS of SULPHURIC ACID, from Brimstone, for Sulphate of Ammonia making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol. References given to Gas Companies.

AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.

Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE. Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.

Head Office MIDDLESBROUGH. Correspondence invited.

W. C. HOLMES & CO., Huddersfield; AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also Improved Patent Rotary Scrubber-Washers.

*** See Advertisement p. 986 of this week's issue.

Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Address: "Braddock Oldham."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

SPECIAL PAINT FOR GAS-WORKS.

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VICTORIA PAINT WORKS,
MANCHESTER.

Telegrams: "ENAMEL." National Telephone 1759.

GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.

For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

THE Undersigned is in a position to supply, at the very lowest Prices, the most suitable kind of BENZOL for enriching Gas, made from Hardman's Patent Carbonization Process, of which I am the Sole Patentee. On application, I would furnish Price on the most reasonable terms; giving advice how to utilize it on the most economical method.

J. HARDMAN, Manufacturing Chemist.
Milton, Staffs.

G. J. EVESON wants a Representative, for Export and Inland Trade, who can sell Coal, Cannel, and Tubes anywhere in the United Kingdom or abroad where representative is not already appointed, either on Commission or Salary, or both, with adequate allowance for expenses.

Apply, by letter, to G. J. EVESON, Corporation Street BIRMINGHAM.

GAS MAIN AND SERVICE LAYER.

WANTED, a competent Man as above. Applicants must state Age and previous Experience, with Reference as to character and last employment. Wages 32s. 6d. per week.

Apply to the MANAGER, Bute Gas-Works, CARDIFF.

DRAUGHTSMAN wishes Engagement in Gas-Works or Contractors' Office. Has Twelve Years' Experience in Gas and General Engineering. Age 27. Good Testimonials.

Address No. 2524, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. Sample and Price on application.
OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore. Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.

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HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.

READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

WANTED, a smart and energetic SHORTHAND CLERK, willing to serve in Shop. One used to Gas-Stoves, and familiar with the London Gas Companies preferred. Age 20 to 25.

Apply, by letter, stating Salary and Experience, to E. W. T. RICHMOND, 93, CHEAPSIDE, E.C.

WANTED, a steady respectable married Man as STOKER in a small Works. He must be used to Engine and Exhauster, and a good Shovel Charger. Constant place to a steady Man.

Apply, stating Age and Wages required, to No. 2525, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS-FITTERS, having a Basket of small Tools, can have PERMANENT EMPLOYMENT in fitting up Tenements with Barrel on the Penny-in-the-Slot System.

Apply, by letter only, with Copies of References to HENRY GREENE & SONS, 34, Greyhound Road, HAMMERSMITH, W.

TO GAS ENGINEERS.

WANTED, a thoroughly qualified Gas and MECHANICAL ENGINEER to take the practical Management of an Engineering Works in the Country.

Salary £100 a year, with a good House free, and Commission.

Apply, by letter only, to LUX, care of Messrs. J. Burbidge & Co., 62, MOORGATE STREET, E.C.

WANTED, a second-hand Station METER, in good condition. Capacity, about 40,000 cubic feet per hour.

Address No. 2522, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Single-Lift Gasholder, 36 feet diameter by 10 feet deep, with Cast-Iron Columns and Counterbalance Weights, complete and in good condition.
Apply to G. HELPS, HINCKLEY.

PURIFIERS.

FOR SALE—Four 8 feet square Purifiers, with Sieves, Bearing-Bars, and Covers. Being removed to make room for larger ones.
Apply to the MANAGER, Gas-Works, Banbury, OXON.

SIX-INCH Hydraulic Main Valves, in perfect working order. Several FOR SALE. Price £2 each. Also DIP-PIPES and other FITTINGS.
Apply, by letter, to No. 2523, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE, cheap—One 20,000 cub. feet per hour Beale's EXHAUSTER, with two 8-inch Disc Valves. Also one to pass 5000 Cubic Feet per hour. Both in perfect condition.
Apply to SAMUEL WHILE, 60, Queen Victoria Street, LONDON, E.C.

FOR SALE—Station Meter, now in use at the Windsor Royal Gas-Works. Capacity 10,000 cubic feet per hour. Being sold in consequence of larger Meter ordered, and which will be fixed shortly.
Offers to be sent to J. H. STRANGE, Secretary, 15, Victoria Street, WINDSOR, by the 3rd of June.

GAS Plant for Sale—
Two Cylindrical STATION METERS, 9000 cubic feet per hour, 8-inch Connections, with Valves and Bye-Passes complete. Good condition.
One MORRIS and CUTLER'S PATENT CONDENSER, 6-inch Connections. Nearly new.
One 6-inch GOVERNOR, with Bye-Pass and Valves. Good condition.
One 6-inch FOUR-WAY VALVE, nearly new.
One GAS REFEREE'S CUBIC FOOT MEASURE, with Water-Tank, &c., complete. Good as new.
Apply to G. W. LUPTON, Manager, Gas-Works, Otley, YORKS.

TENDERS FOR GAS COALS.

THE Directors of the Exmouth Gas Company are prepared to receive TENDERS for the supply of 2500 Tons of Screened or Unscreened Fresh-Wrought GAS COALS.
Tenders to be for price f.o.b. and c.i.f., at Exmouth Docks, between the 1st of July next and the 30th of June, 1896, accompanied by Working Analysis.
Sealed tenders, addressed to the undersigned, and endorsed "Tender for Coal," to be sent in not later than the 1st day of June, 1895.
The Directors do not pledge themselves to accept the lowest or any Tender.

By order,
JAMES T. FOSTER,
Secretary.

Gas-Works, Exmouth,
May 9, 1895.

SOUTH SHIELDS GAS COMPANY.

TO COALOWNERS.

THE Directors of the South Shields Gas Company invite TENDERS for the supply of 40,000 Tons of clean, unscreened GAS COAL, for delivery, into Craft, and at the Company's Depôt, South Shields, as required, over a period of Twelve Months.
The Directors reserve to themselves the right of taking the Coal in one or more lots.
The lowest or any tender not necessarily accepted.
Particulars as to Deliveries, &c., may be obtained at the Gas-Works, on application to Mr. W. J. Warner, the Engineer.
Sealed tenders to be delivered to the undersigned not later than Friday morning, the 24th inst., endorsed "Tender for Coal."

J. H. PENNEY,
Secretary.

Gas Offices, Chapter Row, South Shields,
May 13, 1895.

ROCHESTER, CHATHAM, AND STROOD GASLIGHT COMPANY.

SUPPLY OF GAS COALS.

THE Directors invite Tenders for the supply of about 40,000 Tons of GAS COALS, to be delivered between the 1st of August, 1895, and the 31st of July, 1896.
Further Particulars, with Forms of Tender and Contract, may be had on application.
Sealed tenders, marked "Coals," are to be delivered to me at these Offices, not later than Noon of Thursday, the 6th of June, 1895.

J. M. VEEVERS,
General Manager.

Gas Offices: 95, High Street, Rochester,
May 9, 1895.

ROCHESTER, CHATHAM, AND STROOD GASLIGHT COMPANY.

TAR AND AMMONIACAL LIQUOR.

THE Directors are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR to be produced at their Works at Rochester and Gillingham for One Year commencing the 1st of July next.
The quantity of Tar will be about 800,000 gallons; of Liquor, about 960,000 gallons.
Further Particulars, with Forms of Tender and Contract, may be had on application
Tenders, marked "Tar" or "Liquor," are to be delivered to me at these Offices, not later than Noon of Thursday, the 23rd of May, 1895.
The Directors do not undertake to accept any tender; and security for due fulfilment of the contract must be given, if required.

J. M. VEEVERS,
General Manager.

Gas Offices: 95, High Street, Rochester,
May 9, 1895.

SOUTH YORKSHIRE OR WEST OF ENGLAND GAS COAL.

THE Aldershot Gas and Water Company will require about 3000 Tons of either of the above COALS, for delivery at Tongham or Aldershot Station, per schedule, up to June, 1896.
Tenders, endorsed "Coal," to be sent to the Secretary, on or before the 24th inst.

LEEK URBAN DISTRICT COUNCIL.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the above Council invite TENDERS for the supply of best screened GAS COAL NUTS and CANNEL for One Year from the 1st of July next, to be delivered at Leek Station on the North Staffordshire Railway, at such times and in such quantities as may be required.
Further Particulars and Forms of Tender may be obtained from the undersigned.
Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, by Four o'clock in the afternoon of Monday, the 27th of May inst.
The lowest or any tender will not necessarily be accepted.

By order of the Council,
C. HENSHAW,
Clerk.

Town Hall, Leek,
May 7, 1895.

TO LIME MASTERS.

THE Corporation of Walsall invite TENDERS for the supply of about 800 Tons of LIME, which will be required at their Gas-Works during One Year from the 1st of July next; the deliveries to be in such monthly quantities as the Manager of the Gas-Works may from time to time direct.
The Lime is to be hand-picked and clear from Refuse and Ashes, and to be delivered at Walsall Railway Stations as required.
Payments monthly.
Tenders, sealed and marked outside "Tender for Lime," are to be sent to the undersigned on or before Thursday, the 30th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 11, 1895.

TENDERS FOR GAS COAL.

THE Corporation of Walsall invite TENDERS for the supply of 40,000 Tons of STAVELEY, YORKSHIRE, or any other good GAS COAL, to be delivered during One Year from the 1st of July next, either at the London and North-Western or Midland Railway Stations at Walsall, or the Corporation Siding at the Pleck Gas-Works, as may be required.
Forms of Tender and Specification may be obtained on application to the undersigned.
The Corporation do not bind themselves to accept any tender, and they reserve the right to divide the contract between several firms.
Tenders, sealed and marked outside "Tender for Gas Coal," and stating the price for large Coal and also for Nuts, are to be sent to the undersigned on or before Thursday, the 30th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 11, 1895.

TO OXIDE OF IRON MERCHANTS.

THE Corporation of Birkenhead are prepared to receive TENDERS for the supply of 350 Tons of OXIDE OF IRON.
Forms of Tender and other Information may be obtained from Mr. T. O. Paterson, Gas Engineer, Gas-Works, Thomas Street.
Tenders, sealed and endorsed "Tender for Oxide of Iron," to be sent in to me not later than Five p.m. on Friday, the 24th of May, 1895.
Deliveries to be made within one month of written instructions from the Gas Engineer.
The Corporation do not bind themselves to accept the lowest or any tender.

By order,
ALFRED GILL,
Town Clerk.

Town Hall, Birkenhead,
May 11, 1895.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Corporation of Birkenhead are prepared to receive TENDERS for the supply of COAL, COAL NUTS, CANNEL, and CANNEL NUTS for Gas-Making Purposes for a period of Twelve Months, commencing from the 26th of June, 1895.
Forms of Tender, together with any further Information, may be obtained from Mr. T. O. Paterson, C.E., Gas Engineer, Gas-Works, Birkenhead.
Tenders (accompanied by copy of Analysis), stating the price per ton, delivered on to the Gas-Works Railway Siding, must be sent in to me, sealed and endorsed "Tender for Gas-Works Coal," not later than Five o'clock in the Afternoon of Friday, the 24th of May, 1895.
Also for a supply of STEAM COAL and SLACK, to be delivered at the Pumping-Stations of the Spring Hill, Playbrick Hill, and Borough Road Water-Works for a period of Twelve Months, commencing from the 26th of June, 1895.
Forms of Tender, together with any further Information, may be obtained from Mr. W. A. Richardson, C.E., Water Engineer, Town Hall, Birkenhead.
Tenders, stating the price per ton delivered at the various Pumping-Stations, must be sen in to me, sealed and endorsed "Tender for Water-Works Coal," not later than Five o'clock in the Afternoon of Friday, the 24th of May, 1895.
All deliveries to be made from time to time according to the requirements of the respective Engineers.
The Corporation do not bind themselves to accept the lowest or any tender.

By order,
ALFRED GILL,
Town Clerk.

Town Hall, Birkenhead,
May 11, 1895.

WARWICK GASLIGHT COMPANY.

THE Committee of the above Company are prepared to receive TENDERS for the purchase of their surplus TAR for One or Three Years, commencing July 1, 1895.
For Particulars, apply to the undersigned before the 1st of June next.

WALTER T. TEW,
Manager.

May 8, 1895.

DARWEN CORPORATION GAS-WORKS.

TO TAR DISTILLERS.

THE Gas Committee of the above Cor- poration are prepared to receive TENDERS for all the surplus GAS TAR produced at their Gas-Works for One Year ending March 31, 1896.
Sealed tenders, endorsed "Tar," to be sent to me not later than Twelve Noon, May 27 inst.

CHAS. COSTEKER,
Town Clerk.

May 11, 1895.

THE Directors of the Kildwick Parish Gas Company invite TENDERS for the supply of the whole or part of 3000 Tons of best screened GAS COAL or NUTS, to be delivered free at Kildwick, during the Twelve Months ending June 30, 1896.
The Coal to be delivered at such times and in such quantities as the Manager may direct.
Tenders to be sent in not later than June 7, 1895.
The lowest or any tender not necessarily accepted.

FRED. H. PICKLES,
Manager and Secretary.

Gas-Works, Kildwick,
May 10, 1895.

BLACKROD GAS COMPANY.

THE Directors of the above Company are prepared to receive TENDERS for the Supply of about 900 Tons of GAS COAL or NUTS, to be delivered at Adlington Station (L. & Y. Railway), or White Bear (L. & N.W. Railway), between July, 1895, and June 30, 1896.
The deliveries to be made in such quantities and at such times as may be directed by the Manager.
Tenders, enclosed and endorsed "Coal," are to be delivered to Mr. J. Stott, Market Street, Hindley, near Wigan, not later than Thursday, the 30th day of May, 1895.

By order,
OLIVER SISSONS,
Manager and Secretary.

Gas Offices, Blackrod.

HAMILTON CORPORATION GAS DEPARTMENT.

THE Gas Committee of the Hamilton Corporation invite TENDERS for the supply and erection of a TELESCOPIC GASHOLDER 102 feet and 100 feet diameter, with 30-feet Lifts, and Steel Tank, 104 feet diameter; a TOWER SCRUBBER 60 feet by 10 feet; BATTERY OF LIQUOR PUMPS, CORNISH BOILER, Two 24-feet PURIFIERS, Steel Plate TAR and LIQUOR TANK, RETORT-HOUSE and PURIFIER-HOUSE ROOFS; also for the ERECTION (only) of eighteen sections BATTERY CONDENSER.
Plans and Specifications may be seen at the Gas Office, on and after Thursday, the 16th inst.
Sealed offers to be lodged with the Subscribers not later than Friday, the 24th inst.

WM. POLLOK
P. M. KIRKPATRICK } Town Clerks.

Town House, Hamilton,
May 10, 1895.

NORTH CAMP AND FARNBORO' DISTRICT GAS COMPANY, LIMITED.

TENDERS FOR COAL.

THE Directors of the above Company are desirous of receiving TENDERS for the supply of 500 to 1000 Tons of GAS COAL during the period of One Year from the 1st of August next.
All persons submitting tenders must state the price per ton of 20 cwt. (and whether screened), delivered free to Aldershot Camp Station, South-Eastern Railway; and the person whose tender is accepted will be required to deliver the Coal in such quantities as the Directors may from time to time require until the contract is completed.
Sealed tenders, marked "Tenders for Coal," should be addressed and sent, with latest Analytical Tests, to the undersigned not later than Wednesday, the 22nd inst.

JOHN BAKER,
Secretary.

Billiter House, Billiter Street, E.C.,
May 8, 1895.

TUNBRIDGE WELLS GAS COMPANY.

SALE OF £5000 4½ PER CENT. TUNBRIDGE WELLS GAS DEBENTURE STOCK.

MR. WM. ROPER begs to announce that he has been favoured with Instructions from the Directors of the Tunbridge Wells Gas Company, to SELL BY AUCTION at the Pump Room, Tunbridge Wells, on Friday, the 24th of May, 1895, at Four o'clock in the Afternoon precisely,

£5000 OF TUNBRIDGE WELLS GAS DEBENTURE STOCK,

entitled to Interest at the rate of 4½ per cent. per annum, payable Half Yearly, in—

3	Lots of	£500 each.
5	"	£200 "
20	"	£100 "
10	"	£50 "

The Debenture Stock of the Company, with Interest thereon, is a charge upon the Undertaking of the Company prior to all Shares or Stock of the Company; and the Auctioneer confidently recommends this Stock to all those who are desirous of obtaining a safe Investment for Capital.
Further Particulars and Conditions of Sale may be had at the offices of Messrs. STONE, SIMPSON, AND SON, Solicitors, Church Road; the AUCTIONEER, 49, Mount Pleasant; and Mr. JOHN READ, the Secretary of the Company, 44, High Street, TUNBRIDGE WELLS.

GASHOLDER, 80 feet diameter by 24 feet deep, in good condition, FOR SALE; being replaced by larger one.
Full Particulars on application to No. 2519, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—One 5000 Cubic Feet per hour ROTARY EXHAUSTER and ENGINE combined; also a 5000 Cubic Feet EXHAUSTER, without Engine. Both perfectly new.
Apply QUEEN STREET IRON-WORKS, Ravensthorpe, YORKS.

ST. ANNE'S-ON-THE-SEA GASLIGHT AND COKE COMPANY, LIMITED.

FOR SALE—One Cylindrical Station METER with 6-inch Connections and Bye-Pass; 4000 cubic feet per hour capacity (G. Orme & Co.). Also one 9-inch STATION GOVERNOR, with Valves (Braddock). All in working order.
Offers for same to be addressed to
WILLIAM H. NUTTER,
Secretary and Manager.
Gas Offices, St. Anne's-on-the-Sea,
May 4, 1895.

ST. ANNE'S-ON-THE-SEA GASLIGHT AND COKE COMPANY, LIMITED.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of about 2000 tons of best screened GAS COAL, to be delivered in quantities as required from July 1, 1895, to June 30, 1896.
Sealed tenders, accompanied by Name and Analysis of Coal, and endorsed "Tender for Coal," to be sent to the undersigned not later than the 30th of May inst.
The lowest or any tender not necessarily accepted.
WILLIAM H. NUTTER,
Secretary and Manager.
Gas Offices, St. Anne's-on-the-Sea,
May 4, 1895.

ST. ANNE'S-ON-THE-SEA GASLIGHT AND COKE COMPANY, LIMITED.

TAR AND AMMONIACAL LIQUOR.

THE Directors of the above Company are prepared to receive OFFERS for the surplus TAR and LIQUOR produced at their Works for One Year commencing June 1, 1895.
Coal carbonized, about 2000 Tons.
Sealed tenders, endorsed "Tar and Liquor," to be sent to me not later than May 30 inst.
The highest or any tender not necessarily accepted.
WILLIAM H. NUTTER,
Secretary and Manager.
Gas Offices, St. Anne's-on-the-Sea,
May 4, 1895.

SELBY URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Selby Urban District Council are prepared to receive TENDERS, on or before Noon on Tuesday, the 4th of June next, for 2200 Tons of high-class GAS COAL, delivered free into the Gas-Works Siding at Selby, in such quantities as may be required for a period of One Year, commencing the 1st of July next.
Particulars and printed Forms of Tender may be obtained on application (in writing only) from the undersigned, to whom tenders, duly endorsed "Tender for Coal," must also be addressed.
The lowest or any tender not necessarily accepted.
By order,
MATT. DUNN,
Engineer and Manager.
Gas-Works, Selby,
May 8, 1895.

SOWERBY BRIDGE URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee of the Sowerby Bridge Urban District Council are prepared to receive TENDERS for the supply of 11,000 Tons of best GAS COAL and 1000 Tons of CANNEL required in each year for One, Two, or Three Years from June 1, 1895.
Specifications and Forms of Tender can be obtained by applying to Mr. John Marsland, Engineer and Manager, Gas-Works, Sowerby Bridge.
The Gas Committee do not bind themselves to accept the lowest or any tender.
Tenders must be sent in not later than Monday, May 27, 1895, endorsed "Tender for Coal" or "Cannel" respectively, and addressed to
GODFREY RHODES AND EVANS,
Clerks to the Council.
Commercial Bank Chambers,
Halifax, May 7, 1895.

SOWERBY BRIDGE URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee of the Sowerby Bridge Urban District Council are prepared to receive TENDERS for the supply of 1220 yards of 6-inch Turned and Bored CAST-IRON PIPES required for the Gas-Works.
Also DIGGING TRENCH for same, &c.
Specifications and Forms of Tender can be obtained by applying to Mr. John Marsland, Engineer and Manager, Gas-Works, Sowerby Bridge.
The Committee do not bind themselves to accept the lowest or any tender.
Tenders must be sent in not later than Monday, May 27, 1895, endorsed "Tender for Pipes" or "Digging" respectively, and addressed to
GODFREY RHODES AND EVANS,
Clerks to the Council.
Commercial Bank Chambers,
Halifax, May 7, 1895.

TYLDESLEY URBAN DISTRICT COUNCIL.

THE Gas Committee invite Tenders for the supply of 24 machine-made RETORTS.
Particulars from the Gas Engineer.
Tenders, endorsed "Retorts," to be delivered to me on or before the 20th inst.
The lowest or any tender not necessarily accepted.
FRANK T. WRIGHT,
Clerk.
Tyldesley,
May 10, 1895.

DUKINFIELD URBAN DISTRICT COUNCIL.

TENDERS FOR GAS COAL.

THE Gas Committee of the above Council require TENDERS for 6000 Tons of freshgot screened GAS COAL, delivered at the Gas-Works or at the Sidings of the L. & N.W. or M. S. & L. Railway (Dog Lane) in Dukinfield. Of the above quantity 4000 Tons are to be delivered before the end of August next; and the remaining 2000 Tons in equal monthly quantities ending the 30th of June, 1896.
The Committee will not be bound to accept any tender, nor will any offer be considered except for the best screened Gas Coal.
Tenders, endorsed "Coal," to be here by Noon of Thursday, the 23rd inst., directed to Mr. Councillor Halstead, the Chairman of the Committee.
Any further Information may be had from
HARRISON VEEVERS, C.E.,
Engineer and Secretary.
King Street, Dukinfield,
May 6, 1895.

TAUNTON GASLIGHT AND COKE COMPANY.

TENDERS FOR COAL.

THE Directors are prepared to receive TENDERS for the supply of COAL over One Year from the 1st of July next.
Particulars can be had from the Manager, to whom sealed tenders may be delivered not later than the 1st of June next.
A. EDWARDS,
Secretary and Manager.
May 4, 1895.

TENDERS FOR TAR.

THE Directors are prepared to receive TENDERS for the surplus TAR, over a period commencing the 1st of July next.
Tenders to be sent to the Manager, by the 1st of June next.
A. EDWARDS,
Secretary and Manager.
May 4, 1895.

KNARESBOROUGH URBAN DISTRICT COUNCIL
(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee invite Tenders for about 2000 Tons of unscreened GAS COAL for delivery, in Contractor's Waggons at Knaresborough Station, in such monthly quantities as may be required, for a period of One, Two, or Three Years, commencing July 1 next.
Particulars may be obtained on application to the Manager, Mr. T. Settle.
Tenders, stating price per ton, endorsed "Tender for Coal," and addressed to the Chairman of the Gas Committee, must be sent in on or before the 29th of May, 1895.
The Committee do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.
By order,
THOMAS MAINMAN,
Clerk to the Council.
May 8, 1895.

KNARESBOROUGH URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the purchase of the surplus TAR and LIQUOR produced at their Works for One Year commencing July 1 next. The same will be delivered in Buyer's Tanks at the Railway Station, Knaresborough.
Price per ton for Tar (separate); price per ton for Liquor per degree from 5° upwards.
Coal carbonized, about 2000 Tons per annum.
The Committee also invite TENDERS for the supply of about 80 Tons of good LIME, free from Dirt and Ashes, delivered fresh at Knaresborough Station.
Tenders, stating price per ton, endorsed "Tar and Liquor" or "Lime" as the case may be, and addressed to the Chairman of the Gas Committee, to be sent in on or before the 29th of May, 1895.
By order,
THOS. MAINMAN,
Clerk to the Council.
May 8, 1895.

BOROUGH OF MANSFIELD.

TENDERS FOR COAL AND CANNEL.
TENDERS FOR TAR AND AMMONIACAL LIQUOR.

COALS.—The Gas Committee are pre- pared to receive TENDERS for 1200 Tons of CANNEL and 5600 Tons of best screened GAS COAL, delivered at Mansfield Station for One Year from June 1, 1895, to May 31, 1896.
TAR AND LIQUOR.—TENDERS for TAR AND LIQUOR made during the Year from July 1, 1895, to June 30, 1896. Tenders for Liquor to be made either at a fixed Price per ton or on Sliding Scale regulated by the price of Sulphate.
Tenders, endorsed, to be sent in to the undersigned on or before May 31, 1895.
Particulars and other Information may be obtained from Mr. A. Graham, Engineer and Manager, Gas-Works.
By order of the Committee,
J. HARROP WHITE,
Deputy Town Clerk.
May 2, 1895.

TO COLLIERY OWNERS.

THE Gas Committee of the Corporation of Blackpool are prepared to receive TENDERS for the supply of about 25,000 Tons of COAL and CANNEL for the next Twelve Months from June 1.
Endorsed tenders to be addressed to the Chairman and sent in by the 25th day of May.
Specification and Form of Tender may be had from the undersigned.
JOHN CHEW,
Engineer.
Gas Office, Blackpool,
May 8, 1895.

ACCRINGTON DISTRICT GAS & WATER BOARD.

TENDERS FOR COAL.

THIS Board are prepared to receive TENDERS for the supply of GAS COAL to the Accrington and Great Harwood Works of the Board, for One, Two, or Three Years, commencing on the 1st day of July next. The probable quantity will be about 24,000 tons per annum.
Tenders will be received for the whole or for a portion of the quantity.
The Board reserve the right to accept tenders for the whole or any portion of any quantity offered; but do not bind themselves to accept the lowest or any tender.
Tenders, endorsed "Tender for Coal," and addressed to the Clerk to the Board, Accrington, must be in my hands not later than Wednesday, the 22nd inst.
By order,
CHAS. HARRISON,
General Manager.

ACCRINGTON DISTRICT GAS & WATER BOARD.

TENDERS FOR TAR & AMMONIACAL LIQUOR.

THIS Board are prepared to receive TENDERS for the surplus TAR and AMMONIACAL LIQUOR which may be produced at the Accrington and Great Harwood Works of the Board, during One Year, commencing on the 1st day of July next, and terminating on the 30th of June, 1896.
The quantity of Coal carbonized is about 13,000 Tons at Accrington, and 11,000 Tons at Great Harwood.
Tenders, endorsed "Tar and Liquor," to be addressed to the Clerk to the Accrington District Gas and Water Board, Accrington, and must be in my hands not later than Wednesday, the 22nd inst.
By order,
CHAS. HARRISON,
General Manager.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO IRONFOUNDERS AND ENGINEERS.

THE Gas Committee are prepared to receive TENDERS for the supply and erection of two WROUGHT-IRON ROOFS, at their Portwood Station—No. 1, for Workshops; No. 2, for Sulphate-House.
Drawings and Specifications may be seen at the Millgate Gas-Works, and full Particulars obtained on application to the Engineer, Mr. S. Meunier.
Persons tendering must tender on separate form for the different Roofs; and the Committee do not bind themselves to accept the lowest or any tender.
Tenders, endorsed "Tender for Iron Roof, No. 1" or "No. 2" as the case may be, addressed to the Chairman of the Gas Committee, must be sent in on or before Wednesday, the 22nd inst.
The resolution of the Council "That contractors will be expected to pay the standard rate of wages paid in the district will apply to these contracts."
By order,
WALTER HYDE,
Town Clerk.
Stockport,
May 10, 1895.

CORPORATION OF NOTTINGHAM.
(GAS DEPARTMENT.)

TENDERS FOR COALS.

THE Gas Committee are desirous to receive OFFERS for supplies of COALS, COBBLES, or NUTS for the period terminating the 30th of June, 1896.
The Large Coals and the Cobbles or Nuts are to be separately delivered, where and as from time to time directed, by and at the expense of the Contractors, upon the Gas-Works Siding, Great Northern Railway, in the Eastcroft at Nottingham, and also on the Gas-Works Sidings, Midland Railway, at Radford and Basford respectively; and at and after the rate of one-eighth part of such total quantity in each calendar month commencing with the month of July next, till the Corporation shall be satisfied with the amount of accumulated Stock, and afterwards at such rate as shall be from time to time directed, till the agreed quantity shall have been delivered.
The Coals, Cobbles, or Nuts are to be the best of their respective kinds, freshly wrought and well screened (description, sizes, and inclination of screen to be specified), to be as free as possible from Sulphur Bats, Bind, Refuse, and Dirt, and shall be weighed (20 cwt. to the ton) upon the Corporation Machines, or upon such other Machines as may be mutually agreed upon.
Payments will be made monthly, if and so long as the contract shall be duly fulfilled.
The Corporation do not bind themselves to accept the lowest or any tender.
Further Information and Forms on which the tenders must be made may be obtained on application to me, at the General Manager's Office; and the tenders (sealed), specifying the description of Coals, the Seam, and the Pits at which they are to be raised, and stating the prices for deliveries at the several places, and in manner and subject to the conditions aforesaid, must be delivered to Sir Samuel George Johnson, Kt., Town Clerk, on or before Saturday, the 18th day of May, 1895
By order,
WILLIAM REGINALD CHESTER, M.Inst.C.E.,
Engineer and General Manager
Corporation Gas Offices, George Street,
Nottingham, April 25, 1895.

BUXTON LOCAL BOARD.

CONTRACT FOR TAR AND LIQUOR.

THE Buxton Local Board invite TENDERS for the purchase of the TAR and AMMONIACAL LIQUOR produced at their Works in Ashwood Dale, during one or more years.

Particulars to be obtained of Mr. Geo. Smedley, Gas Department, Town Hall, Buxton.

The Board do not guarantee to accept the highest or any tender.

Tenders, endorsed "Tender for Tar, &c.," to be addressed to the Chairman of the Gas Committee, and sent in not later than the 1st of June prox.

By order,
JOSIAH TAYLOR,
Clerk to the Board.

Buxton, May 4, 1895.

TENDERS FOR GAS COAL.

THE Corporation of Droitwich invite TENDERS for the supply of from 1100 to 1300 Tons of best screened GAS COAL, to be delivered free at Droitwich (G.W.) Railway Station, at such times and in such quantities as may be required, prior to the 31st of May, 1896.

Particulars and Form of Tender may be obtained on application to the Manager of the Gas-Works.

Sealed tenders, on the form provided for the purpose (with the Analysis of the Coal to be supplied), endorsed "Tender for Gas Coal," to be sent to the undersigned on or before the 24th of May inst.

The Corporation do not bind themselves to accept the lowest or any tender.

S. JOHN TOMBS,
Town Clerk.

Droitwich, May 1, 1895.

NOTICE.

TO GAS ENGINEERS AND OTHERS.

MESSRS. CLAPHAM BROS., Limited, Keighley, Yorkshire, are no longer authorized to Manufacture my CONDENSER and WASHER-SCRUBBERS.

The above-named Gas Apparatus are erected and giving entire satisfaction at the following places: Neath, Lincoln, Sheffield, Ellesmere, Mountain Ash, Malden, Cullingworth, Montreal (Canada), Woodstock (South Africa), Cape Town (South Africa), &c.

These Appliances can now be obtained solely of the undersigned.

Winchester House, London, E.C. J. A. KELMAN.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.
B Lombard Street,
NEWCASTLE-ON-TYNE
W. RICHARDSON, Fitter.

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

The LAW GUARANTEE & TRUST SOCIETY, LIMITED,

GUARANTEES FIDELITY.

Send for complete Prospectus, containing Balance-Sheet, Copy of Policy, &c., &c.

HEAD OFFICE:
49, CHANCERY LANE, LONDON, W.C.

ALFRED WILLIAMS & CO.
(MATTHEW MILDRED)
71, 72 & 73, BANKSIDE,
SOUTHWARK, S.E.
UNIVERSAL PROVIDERS
FOR
GAS, WATER & SEWAGE WORKS.
ENGINEERS & CONTRACTORS
FOR THE ERECTION OF COMPLETE GAS AND WATER WORKS, AND FOR RENEWALS AND EXTENSIONS OF EVERY DESCRIPTION.
PLANS & ESTIMATES ON APPLICATION.
MAIN LAYING AND RETORT SETTING.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS:—

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE, 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar . . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY
FOR ENGINEERS.

STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.

London Office:
90, CANNON STREET, E.C.

T. B. KITTEL, SHEFFIELD.
CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL
ENGLISH & SCOTCH CANNELS.
REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON APPLICATION.
T. B. KITTEL, SHEFFIELD.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.

SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LOW MOOR BLACK BED GAS COAL.

YIELD OF GAS PER TON · 10,375 CUBIC FEET.
ILLUMINATING POWER · 17·50 SPERM CANDLES.
COKE · · · · · · · 75 PER CENT.

Prices, f.o.r. or f.o.b., on application to

GEORGE & JOHN HAIGH,
RAVENS LODGE AND CONYERS' COLLIERIES,
DEWSBURY.

A TRIAL IS RESPECTFULLY SOLICITED.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO.,
Central Plumbing Works, Town Hall Square,
BOLTON.

Practical Makers of all kinds of Saturators, and Specialists in every description of Lead Work required in connection with Sulphate Plants.

Special attention to Repairs.

Improved Lead-Burning Machines, Sulphate Bagging Machines, Copper Scoops, &c.

HIGHEST REFERENCES ON APPLICATION.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Bombay Gas Company, San Paulo Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY, LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON, FITTER.

THE DRUM

FOR PUMPING AIR, WATER, SEMI-FLUIDS, &c

See Advertisement in last and next issue.

INCANDESCENT GAS-LIGHT

NOTICE.

The Incandescent Gas-Light Company, Limited, Hereby Give Notice, that Actions will be brought to restrain Infringements of their Patents against all persons directly or indirectly taking part in making, using, or selling apparatus for Incandescent Gas Lighting called "De Mare System." All persons taking part in the Infringement of the above-mentioned Patents will be liable not only to an Injunction and Damages, but to costs as between Solicitor and Client; the validity of such Patents having been established, and a certificate to that effect granted by the Honourable Mr. Justice Romer.

(Signed) FAITHFULL AND OWEN,
11, Victoria Street, S.W.,
Solicitors to the Incandescent Gas-Light Company, Limited.

NOTICE.

The Incandescent Gas-Light Company, Limited, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

> "The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited, v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

> "The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) FAITHFULL AND OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.

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GAS-FITTING MANUFACTURERS.

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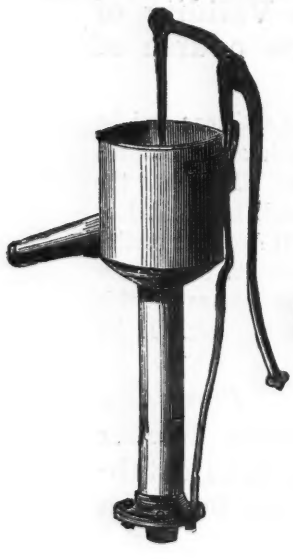

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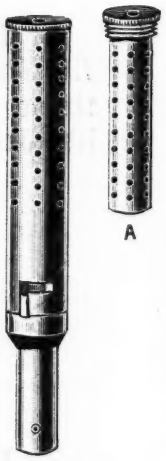

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These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

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Strongly recommended where EXCESSIVE HEATS have to be maintained.

KENT'S THICK GAS COAL

RAISED AT

The Wharncliffe Woodmoor Colliery,

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Yield of Gas, nearly 12,000 *Cubic Feet per ton of Coal; and Illuminating Power nearly* 17½ *Candles.*

The following is a complete ANALYSIS made by Mr. R. O. PATERSON, C.E., Gas-Works, Cheltenham:—

Specific Gravity (Water 1)	1·276
Weight of One Cubic Foot	79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal	2·68 per cent.
Volatile Matter	35·60 ,,
Fixed Carbon	58·80 ,,
Sulphur	0·96 ,,
Ash	1·96 ,,

COMMERCIAL ANALYSIS.

Gas per Ton of Coal	11,760 cub. feet.
Gas per Cubic Foot of Coal	418 ,,
Illuminating Power	17·44 candles.
Value of One Cubic Foot in Sperm	418 grains.
Value per Ton of Coal in Sperm	703 lbs.
Coke per Ton of Coal	1367 ,,
Coke	61·05 per cent.
Ash in Coke	3·21 ,,
Sulphur Eliminated with Volatile Products per Ton of Coal	9·4 lbs.
Sulphur in Coke per Ton of Coal	12 ,,
Ammoniacal Liquor per Ton of Coal	19·7 galls.
Tar per Ton of Coal	12·2 ,,

R. O. PATERSON, C.E.

Gas-Works, Cheltenham, 8th August, 1894.

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Wharncliffe Woodmoor Colliery Co LIMITED,

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Or to Mr. W. H. HARVEY,

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TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,

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COUNTY OF DURHAM.

Available output up to 5000 tons per day. Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

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SEAHAM HARBOUR, COUNTY OF DURHAM.

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WORKED BY THE

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OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

The Analysis made by Messrs. J. and H. T. Pattinson, Public Analysts for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a Working Analysis made of these Coals by the Tudhoe and Sunderland Bridge Gas Company:—

[COPY.]

TUDHOE AND SUNDERLAND BRIDGE GAS COMPANY.

Tudhoe Gas-Works, Spennymoor, 8th June, 1893.

Messrs. The

WEARDALE IRON & COAL COMPANY, LTD.

GENTLEMEN,

For the last two months we have used your **THORNLEY GAS COAL** exclusively at these gas-works; and I have pleasure in herewith giving you the actual results obtained during the trial.

Yield of Gas per ton: 10,300 cubic feet.

Yield of Coke: 13½ cwt.

Illuminating Power of Gas, average of a series of tests, **17 Sperm Candles.**

The Coke was of excellent quality.

The following is a complete ultimate Analysis of the Coal.

	Per Cent.
Carbon	83·128
Hydrogen	5·116
Oxygen	7·401
Nitrogen	0·585
Sulphur	0·620
Ash	3·130
Water	0·020
	100·000

Analysis of the Coke.

Carbon	93·31
Sulphur	0·61
Ash	5·00
Moisture	1·08
	100·00

I am, Gentlemen,

Yours truly,

A. B. COWAN,

Manager.

For Price, &c., apply to the

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NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

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For Carbon Bisulphide, Sulphuretted Hydrogen, and Carbonic Acid in Coal Gas.

The Materials for the above Tests may be obtained from

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Analysis: 12,600 feet of 19-candle gas per ton.

Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.

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Free from Resin.

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1 Gallon does the same Work as 56 lbs. of other mixtures.

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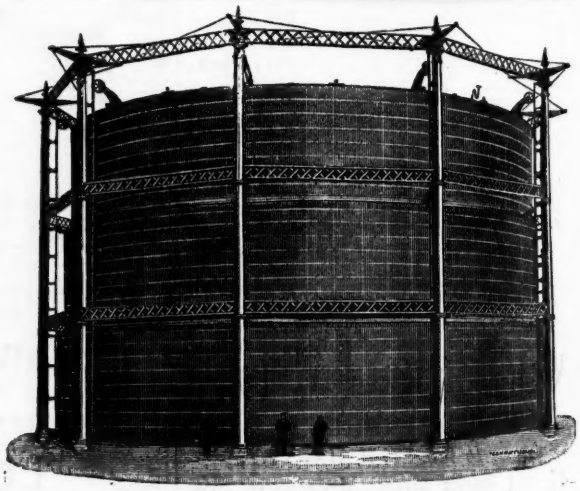

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And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Preston	1,500,000 Cub. Ft.
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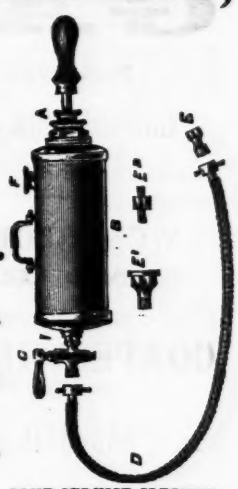

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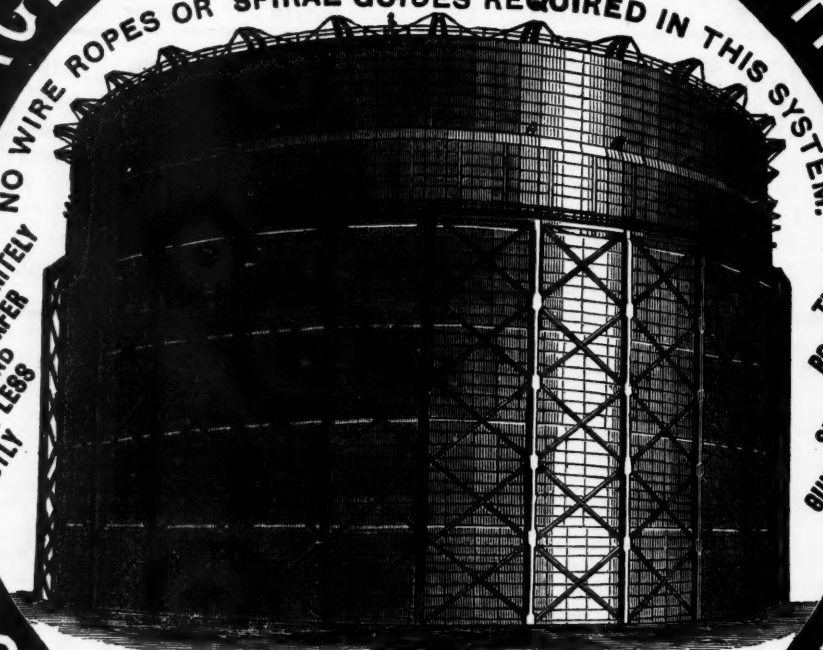

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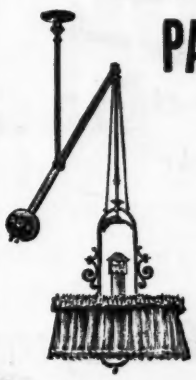

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